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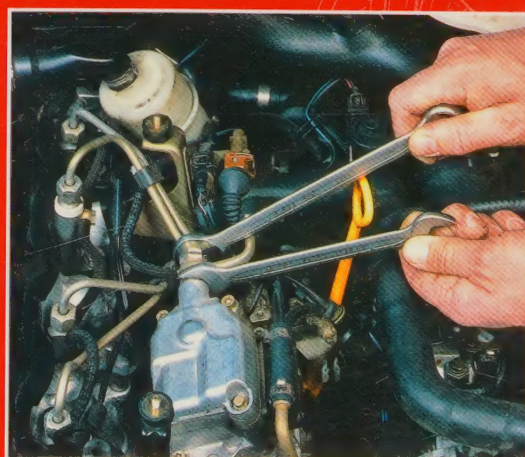
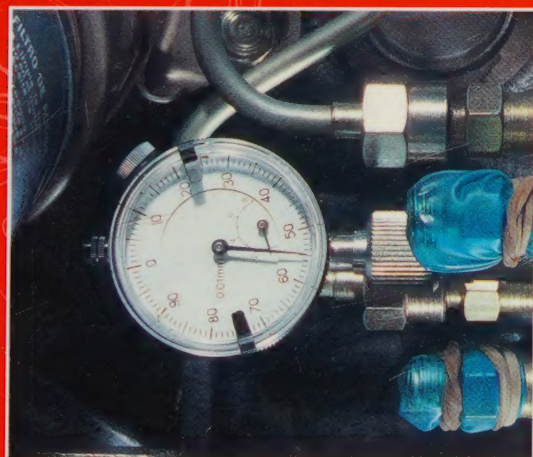
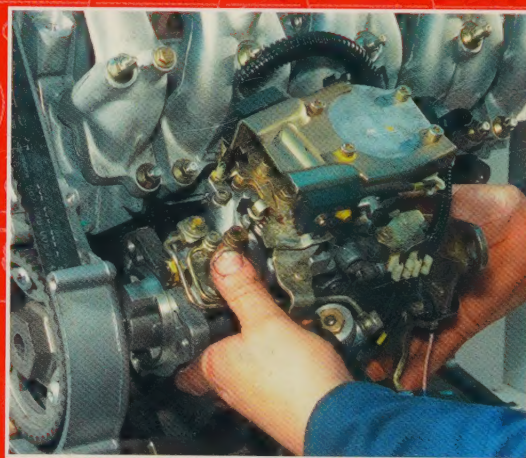
HAYNES

DIESEL ENGINE
SYSTEMS &

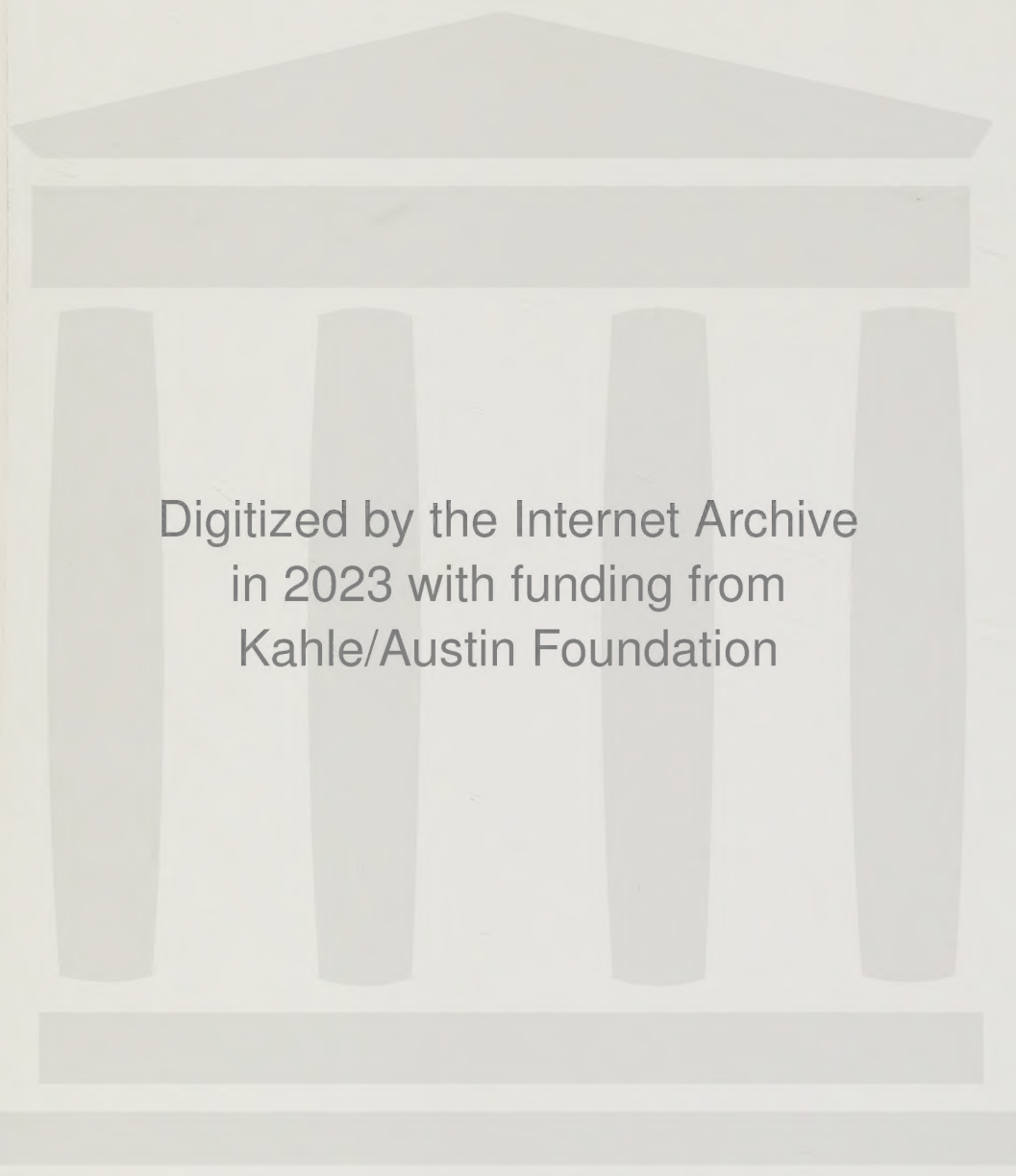
DATA BOOK

COVERING DIESEL ENGINED CARS AND LIGHT COMMERCIAL VEHICLES

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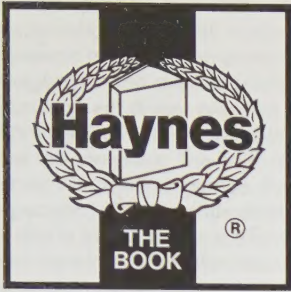


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Diesel Engine Systems & Data Book

Steve Rendle and Martynn Randall

The Haynes Manual providing descriptions and explanations of most modern diesel engine systems and their components. Maintenance, diagnostic and overhaul data for virtually all diesel-engined cars and light commercial vehicles available in the UK during the last ten years.

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Chapter 7 *Adjustments and checks*

Chapter 8 *Maintenance and repair operations*

Chapter 9 *Fault diagnosis*

Chapter 10 *Maintenance and repair data*

This manual provides descriptions and explanations of most modern diesel engine systems and their components. Maintenance, diagnostic and overhaul data is provided for virtually all diesel-engined cars and light commercial vehicles available in the UK during the last ten years. The book is intended for the small independent garage, the mobile tune-up specialist, and the enthusiastic DIY mechanic – that is to say, for people who are familiar with the repair and maintenance of vehicles, but may not have extensive specific experience of diesel engines and injection systems.

The manual is divided into ten main Chapters:

Chapter 1 provides a basic introduction to the diesel engine and its associated systems.

Chapter 2 looks in detail at the various diesel injection systems found on modern vehicles.

Chapter 3 describes the engine electrical systems, and provides maintenance and test procedures for the electrical system components.

Chapter 4 covers ancillary equipment such as turbochargers and vacuum pumps.

Chapter 5 gives details of the various emission control systems likely to be encountered on modern diesel engines.

Chapter 6 looks at the tools and equipment

needed for maintenance, diagnosis and repair.

Chapter 7 provides information on the various checks and adjustments which can be made on many systems.

Chapter 8 describes engine maintenance and repair operations which are unique to, or particularly important on, diesel engines.

Chapter 9 provides fault diagnosis charts and notes.

Chapter 10 gives tune-up, maintenance and repair data in tabular form. At the beginning of Chapter 10 a detailed explanation of the data presentation is provided – this should be read before using that Chapter.

Acknowledgements

Thanks are due to the various vehicle and equipment manufacturers and importers for providing technical literature, data and illustrations for this book. These include Lucas CAV Limited and Robert Bosch Limited for the use of their illustrations. Thanks are also due to all those people at Sparkford who helped in the production of this book, particularly Matthew Minter and Julian McGeoch who

provided the basis from which this book was developed.

This book is not a direct reproduction of the vehicle manufacturers' data, and its publication should not be taken as implying any technical approval by the vehicle manufacturers or importers.

We take great pride in the accuracy of

information given in this manual, but vehicle manufacturers make alterations and design changes during the production run of a particular vehicle of which they do not inform us. No liability can be accepted by the authors or publishers for loss, damage or injury caused by any errors in, or omissions from, the information given.

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0.4 Routine maintenance

General

Although this book does not provide maintenance schedules and detailed maintenance procedures (although general procedures are provided in Chapters 7 and 8), the following points should be taken into account when working through the vehicle manufacturer's maintenance schedule.

Maintenance intervals

When both time and mileage intervals are specified by the manufacturer, the time interval should be followed if the specified mileage is not covered within the time stated. This is necessary because some fluids and systems deteriorate with time as well as with use. In particular, water trap draining and fuel filter changes should not be neglected on low-mileage vehicles. More water may accumulate in the fuel system of a vehicle which stands idle for long periods than in one which is in constant use. If water or dirt get past the fuel filter and into the injection system, serious damage may result. A clean filter is also less likely to suffer from waxing in cold weather.

Oil change intervals tend to be shorter for diesel engines than for comparable petrol

engines, because more contamination and fuel dilution of the oil occurs in the diesel. Sulphur compounds in diesel fuel are particularly detrimental to the oil; if fuel with a higher than normal sulphur content has to be used, oil change intervals must be reduced. (The current EEC standard allows a maximum diesel content in diesel fuel for road vehicles of 0.2%, but in other countries it may be higher. A high sulphur content may also be found in fuels such as marine diesel.)

Adverse operating conditions

Vehicles used under adverse conditions may require more frequent maintenance. 'Adverse conditions' include the following:

- Mainly short journeys*
- Full-time towing or taxi work*
- Operating in extremely hot or cold climates*
- Driving on unmade roads or in dusty conditions*
- Use of inferior fuel*

Timing belt renewal

When a toothed belt is used to drive the camshaft and/or injection pump, periodic renewal is normally specified. *If a camshaft drivebelt breaks or slips in service, extensive*

engine damage will almost certainly result from the ensuing piston/valve contact. Observe the specified intervals for inspection and renewal, even if the belt appears to be in good condition. Renew a belt which is obviously frayed, or which has been contaminated with oil or fuel, without question. Renew idler or tensioner rollers at the same time if they show shake or roughness when spun, and the sprockets if they are damaged.

Cooling system maintenance

Unless otherwise specified, the coolant antifreeze concentration should be checked at the beginning of each winter, and made good if necessary. Coolant should generally be renewed every two years, in order to maintain its corrosion-inhibiting qualities; note however, that some manufacturers claim to have a 'sealed-for-life' cooling system, often filled with their own brand of coolant (this coolant may not be compatible with other brands).

After draining the old coolant, take the opportunity to flush the system if necessary, and renew any hoses which are not in good condition.

Recommended lubricants and fluids

The following are general recommendations only. Observe the vehicle manufacturer's specifications when they differ from those given here.

Engine oil

The properties necessary in an oil for diesel engines are not identical to those needed for petrol engines. This is due to the higher mechanical loads imposed by compression ignition, and to the different effects of unburnt fuel and combustion products on the oil. When a turbocharger is fitted, the oil must also be able to cope with extremely high temperatures and rotational speeds.

For temperate climates, most manufacturers specify the use of multigrade engine oil to API CE, CCMC PD2/D4, ACEA B3-96, or equivalent (or higher) ratings.

API (American Petroleum Institute) ratings show the performance of the oil for both petrol and diesel applications. Petrol ratings begin with the letter 'S' for spark ignition, and 'C' for compression ignition. The second letter denotes the rating, with 'A' being the lowest.

The higher the second letter in the alphabet, the better the rating.

CCMC (Constructors' Committee of the Common Market) ratings fall into three categories; 'G' for gasoline (petrol), 'D' for commercial diesel, and 'PD' for passenger diesel. Each rating is followed by a number. The higher the number, the better the rating.

ACEA (Association des Constructeurs Européens d'Automobiles) ratings also fall into three categories 'A' for petrol engines, 'B' for 'light-duty' diesel engines, and 'E' for 'heavy-duty' diesel engines. ACEA standards replaced CCMC standards in Europe from January 1st 1996, and hence the ratings include '96', eg, 'B1-96' (this year code is likely to be updated in the future). Each rating letter is followed by a number ('1', '2' or '3' at the time of writing), and the higher the number, the better the rating.

Coolant

Modern engines often expose the coolant to several different metals – for instance iron,

aluminium and copper – which in the presence of plain water will interact and rust or corrode rapidly. For this reason, it is essential that the coolant contains a corrosion inhibitor, even when freezing conditions are not expected. When hard water is used in the cooling system, a scale inhibitor is also required. The corrosion and scale inhibitors lose their effectiveness after a while, so coolant must be renewed periodically – typically every two years.

Antifreeze with a methanol content is particularly to be avoided. Methanol does lower the freezing point, but is highly poisonous and inflammable; it also tends to evaporate in use, so reducing the level of protection.

Some vehicle manufacturers (notably VW/Audi) use their own brand of antifreeze in vehicles when new. Certain of these antifreeze products will not mix with other brands, so the vehicle manufacturer's recommendations should always be followed when renewing antifreeze or topping up.

Working on your car can be dangerous. This page shows just some of the potential risks and hazards, with the aim of creating a safety-conscious attitude.

General hazards

Scalding

- Don't remove the radiator or expansion tank cap while the engine is hot.
- Engine oil, automatic transmission fluid or power steering fluid may also be dangerously hot if the engine has recently been running.

Burning

- Beware of burns from the exhaust system and from any part of the engine. Brake discs and drums can also be extremely hot immediately after use.

Crushing

- When working under or near a raised vehicle, always supplement the jack with axle stands, or use drive-on ramps.

Never venture under a car which is only supported by a jack.

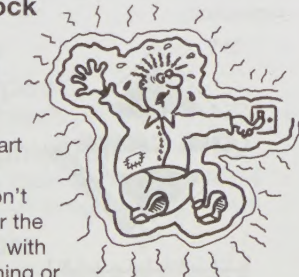
- Take care if loosening or tightening high-torque nuts when the vehicle is on stands. Initial loosening and final tightening should be done with the wheels on the ground.

Fire

- Fuel is highly flammable; fuel vapour is explosive.
- Don't let fuel spill onto a hot engine.
- Do not smoke or allow naked lights (including pilot lights) anywhere near a vehicle being worked on. Also beware of creating sparks (electrically or by use of tools).
- Fuel vapour is heavier than air, so don't work on the fuel system with the vehicle over an inspection pit.
- Another cause of fire is an electrical overload or short-circuit. Take care when repairing or modifying the vehicle wiring.
- Keep a fire extinguisher handy, of a type suitable for use on fuel and electrical fires.

Electric shock

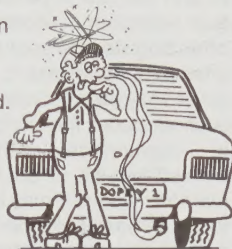
- Ignition HT voltage can be dangerous, especially to people with heart problems or a pacemaker. Don't work on or near the ignition system with the engine running or the ignition switched on.



- Mains voltage is also dangerous. Make sure that any mains-operated equipment is correctly earthed. Mains power points should be protected by a residual current device (RCD) circuit breaker.

Fume or gas intoxication

- Exhaust fumes are poisonous; they often contain carbon monoxide, which is rapidly fatal if inhaled. Never run the engine in a confined space such as a garage with the doors shut.
- Fuel vapour is also poisonous, as are the vapours from some cleaning solvents and paint thinners.



Poisonous or irritant substances

- Avoid skin contact with battery acid and with any fuel, fluid or lubricant, especially antifreeze, brake hydraulic fluid and Diesel fuel. Don't syphon them by mouth. If such a substance is swallowed or gets into the eyes, seek medical advice.
- Prolonged contact with used engine oil can cause skin cancer. Wear gloves or use a barrier cream if necessary. Change out of oil-soaked clothes and do not keep oily rags in your pocket.
- Air conditioning refrigerant forms a poisonous gas if exposed to a naked flame (including a cigarette). It can also cause skin burns on contact.

Asbestos

- Asbestos dust can cause cancer if inhaled or swallowed. Asbestos may be found in gaskets and in brake and clutch linings. When dealing with such components it is safest to assume that they contain asbestos.

Special hazards

Hydrofluoric acid

- This extremely corrosive acid is formed when certain types of synthetic rubber, found in some O-rings, oil seals, fuel hoses etc, are exposed to temperatures above 400°C. The rubber changes into a charred or sticky substance containing the acid. *Once formed, the acid remains dangerous for years. If it gets onto the skin, it may be necessary to amputate the limb concerned.*
- When dealing with a vehicle which has suffered a fire, or with components salvaged from such a vehicle, wear protective gloves and discard them after use.

The battery

- Batteries contain sulphuric acid, which attacks clothing, eyes and skin. Take care when topping-up or carrying the battery.
- The hydrogen gas given off by the battery is highly explosive. Never cause a spark or allow a naked light nearby. Be careful when connecting and disconnecting battery chargers or jump leads.

Air bags

- Air bags can cause injury if they go off accidentally. Take care when removing the steering wheel and/or facia. Special storage instructions may apply.

Diesel injection equipment

- Diesel injection pumps supply fuel at very high pressure. Take care when working on the fuel injectors and fuel pipes.



Warning: Never expose the hands, face or any other part of the body to injector spray; the fuel can penetrate the skin with potentially fatal results.

Remember...

DO

- Do use eye protection when using power tools, and when working under the vehicle.
- Do wear gloves or use barrier cream to protect your hands when necessary.
- Do get someone to check periodically that all is well when working alone on the vehicle.
- Do keep loose clothing and long hair well out of the way of moving mechanical parts.
- Do remove rings, wristwatch etc, before working on the vehicle – especially the electrical system.
- Do ensure that any lifting or jacking equipment has a safe working load rating adequate for the job.

DON'T

- Don't attempt to lift a heavy component which may be beyond your capability – get assistance.
- Don't rush to finish a job, or take unverified short cuts.
- Don't use ill-fitting tools which may slip and cause injury.
- Don't leave tools or parts lying around where someone can trip over them. Mop up oil and fuel spills at once.
- Don't allow children or pets to play in or near a vehicle being worked on.

0.6 General repair procedures

Whenever servicing, repair or overhaul work is carried out on the car or its components, observe the following procedures and instructions. This will assist in carrying out the operation efficiently and to a professional standard of workmanship.

Joint mating faces and gaskets

When separating components at their mating faces, never insert screwdrivers or similar implements into the joint between the faces in order to prise them apart. This can cause severe damage which results in oil leaks, coolant leaks, etc upon reassembly. Separation is usually achieved by tapping along the joint with a soft-faced hammer in order to break the seal. However, note that this method may not be suitable where dowels are used for component location.

Where a gasket is used between the mating faces of two components, a new one must be fitted on reassembly; fit it dry unless otherwise stated in the repair procedure. Make sure that the mating faces are clean and dry, with all traces of old gasket removed. When cleaning a joint face, use a tool which is unlikely to score or damage the face, and remove any burrs or nicks with an oilstone or fine file.

Make sure that tapped holes are cleaned with a pipe cleaner, and keep them free of jointing compound, if this is being used, unless specifically instructed otherwise.

Ensure that all orifices, channels or pipes are clear, and blow through them, preferably using compressed air.

Oil seals

Oil seals can be removed by levering them out with a wide flat-bladed screwdriver or similar implement. Alternatively, a number of self-tapping screws may be screwed into the seal, and these used as a purchase for pliers or some similar device in order to pull the seal free.

Whenever an oil seal is removed from its working location, either individually or as part of an assembly, it should be renewed.

The very fine sealing lip of the seal is easily damaged, and will not seal if the surface it contacts is not completely clean and free from scratches, nicks or grooves. If the original sealing surface of the component cannot be restored, and the manufacturer has not made provision for slight relocation of the seal relative to the sealing surface, the component should be renewed.

Protect the lips of the seal from any surface which may damage them in the course of fitting. Use tape or a conical sleeve where possible. Lubricate the seal lips with oil before fitting and, on dual-lipped seals, fill the space between the lips with grease.

Unless otherwise stated, oil seals must be fitted with their sealing lips toward the lubricant to be sealed.

Use a tubular drift or block of wood of the appropriate size to install the seal and, if the seal housing is shouldered, drive the seal down to the shoulder. If the seal housing is

unshouldered, the seal should be fitted with its face flush with the housing top face (unless otherwise instructed).

Screw threads and fastenings

Seized nuts, bolts and screws are quite a common occurrence where corrosion has set in, and the use of penetrating oil or releasing fluid will often overcome this problem if the offending item is soaked for a while before attempting to release it. The use of an impact driver may also provide a means of releasing such stubborn fastening devices, when used in conjunction with the appropriate screwdriver bit or socket. If none of these methods works, it may be necessary to resort to the careful application of heat, or the use of a hacksaw or nut splitter device.

Studs are usually removed by locking two nuts together on the threaded part, and then using a spanner on the lower nut to unscrew the stud. Studs or bolts which have broken off below the surface of the component in which they are mounted can sometimes be removed using a stud extractor. Always ensure that a blind tapped hole is completely free from oil, grease, water or other fluid before installing the bolt or stud. Failure to do this could cause the housing to crack due to the hydraulic action of the bolt or stud as it is screwed in.

When tightening a castellated nut to accept a split pin, tighten the nut to the specified torque, where applicable, and then tighten further to the next split pin hole. Never slacken the nut to align the split pin hole, unless stated in the repair procedure.

When checking or retightening a nut or bolt to a specified torque setting, slacken the nut or bolt by a quarter of a turn, and then retighten to the specified setting. However, this should not be attempted where angular tightening has been used.

For some screw fastenings, notably cylinder head bolts or nuts, torque wrench settings are no longer specified for the latter stages of tightening, "angle-tightening" being called up instead. Typically, a fairly low torque wrench setting will be applied to the bolts/nuts in the correct sequence, followed by one or more stages of tightening through specified angles.

Locknuts, locktabs and washers

Any fastening which will rotate against a component or housing during tightening should always have a washer between it and the relevant component or housing.

Spring or split washers should always be renewed when they are used to lock a critical component such as a big-end bearing retaining bolt or nut. Locktabs which are folded over to retain a nut or bolt should always be renewed.

Self-locking nuts can be re-used in non-critical areas, providing resistance can be felt when the locking portion passes over the bolt or stud thread. However, it should be noted that self-locking stiffnuts tend to lose their

effectiveness after long periods of use, and should then be renewed as a matter of course.

Split pins must always be replaced with new ones of the correct size for the hole.

When thread-locking compound is found on the threads of a fastener which is to be re-used, it should be cleaned off with a wire brush and solvent, and fresh compound applied on reassembly.

Special tools

Some repair procedures in this manual entail the use of special tools such as a press, two or three-legged pullers, spring compressors, etc. Wherever possible, suitable readily-available alternatives to the manufacturer's special tools are described, and are shown in use. In some instances, where no alternative is possible, it has been necessary to resort to the use of a manufacturer's tool, and this has been done for reasons of safety as well as the efficient completion of the repair operation. Unless you are highly-skilled and have a thorough understanding of the procedures described, never attempt to bypass the use of any special tool when the procedure described specifies its use. Not only is there a very great risk of personal injury, but expensive damage could be caused to the components involved.

Environmental considerations

When disposing of used engine oil, brake fluid, antifreeze, etc, give due consideration to any detrimental environmental effects. Do not, for instance, pour any of the above liquids down drains into the general sewage system, or onto the ground to soak away. Many local council refuse tips provide a facility for waste oil disposal, as do some garages. If none of these facilities are available, consult your local Environmental Health Department, or the National Rivers Authority, for further advice.

With the universal tightening-up of legislation regarding the emission of environmentally-harmful substances from motor vehicles, most vehicles have tamperproof devices fitted to the main adjustment points of the fuel system. These devices are primarily designed to prevent unqualified persons from adjusting the fuel/air mixture, with the chance of a consequent increase in toxic emissions. If such devices are found during servicing or overhaul, they should, wherever possible, be renewed or refitted in accordance with the manufacturer's requirements or current legislation.



OIL BANK LINE
0800 66 33 66

Note: It is antisocial and illegal to dump oil down the drain. To find the location of your local oil recycling bank, call this number free.

Length (distance)

Inches (in)	x 25.4 = Millimetres (mm)	x 0.0394 = Inches (in)
Feet (ft)	x 0.305 = Metres (m)	x 3.281 = Feet (ft)
Miles	x 1.609 = Kilometres (km)	x 0.621 = Miles

Volume (capacity)

Cubic inches (cu in; in ³)	x 16.387 = Cubic centimetres (cc; cm ³)	x 0.061 = Cubic inches (cu in; in ³)
Imperial pints (Imp pt)	x 0.568 = Litres (l)	x 1.76 = Imperial pints (Imp pt)
Imperial quarts (Imp qt)	x 1.137 = Litres (l)	x 0.88 = Imperial quarts (Imp qt)
Imperial quarts (Imp qt)	x 1.201 = US quarts (US qt)	x 0.833 = Imperial quarts (Imp qt)
US quarts (US qt)	x 0.946 = Litres (l)	x 1.057 = US quarts (US qt)
Imperial gallons (Imp gal)	x 4.546 = Litres (l)	x 0.22 = Imperial gallons (Imp gal)
Imperial gallons (Imp gal)	x 1.201 = US gallons (US gal)	x 0.833 = Imperial gallons (Imp gal)
US gallons (US gal)	x 3.785 = Litres (l)	x 0.264 = US gallons (US gal)

Mass (weight)

Ounces (oz)	x 28.35 = Grams (g)	x 0.035 = Ounces (oz)
Pounds (lb)	x 0.454 = Kilograms (kg)	x 2.205 = Pounds (lb)

Force

Ounces-force (ozf; oz)	x 0.278 = Newtons (N)	x 3.6 = Ounces-force (ozf; oz)
Pounds-force (lbf; lb)	x 4.448 = Newtons (N)	x 0.225 = Pounds-force (lbf; lb)
Newtons (N)	x 0.1 = Kilograms-force (kgf; kg)	x 9.81 = Newtons (N)

Pressure

Pounds-force per square inch (psi; lbf/in ² ; lb/in ²)	x 0.070 = Kilograms-force per square centimetre (kgf/cm ² ; kg/cm ²)	x 14.223 = Pounds-force per square inch (psi; lbf/in ² ; lb/in ²)
Pounds-force per square inch (psi; lbf/in ² ; lb/in ²)	x 0.068 = Atmospheres (atm)	x 14.696 = Pounds-force per square inch (psi; lbf/in ² ; lb/in ²)
Pounds-force per square inch (psi; lbf/in ² ; lb/in ²)	x 0.069 = Bars	x 14.5 = Pounds-force per square inch (psi; lbf/in ² ; lb/in ²)
Pounds-force per square inch (psi; lbf/in ² ; lb/in ²)	x 6.895 = Kilopascals (kPa)	x 0.145 = Pounds-force per square inch (psi; lbf/in ² ; lb/in ²)
Kilopascals (kPa)	x 0.01 = Kilograms-force per square centimetre (kgf/cm ² ; kg/cm ²)	x 98.1 = Kilopascals (kPa)
Millibar (mbar)	x 100 = Pascals (Pa)	x 0.01 = Millibar (mbar)
Millibar (mbar)	x 0.0145 = Pounds-force per square inch (psi; lbf/in ² ; lb/in ²)	x 68.947 = Millibar (mbar)
Millibar (mbar)	x 0.75 = Millimetres of mercury (mmHg)	x 1.333 = Millibar (mbar)
Millibar (mbar)	x 0.401 = Inches of water (inH ₂ O)	x 2.491 = Millibar (mbar)
Millimetres of mercury (mmHg)	x 0.535 = Inches of water (inH ₂ O)	x 1.868 = Millimetres of mercury (mmHg)
Inches of water (inH ₂ O)	x 0.036 = Pounds-force per square inch (psi; lbf/in ² ; lb/in ²)	x 27.68 = Inches of water (inH ₂ O)

Torque (moment of force)

Pounds-force inches (lbf in; lb in)	x 1.152 = Kilograms-force centimetre (kgf cm; kg cm)	x 0.868 = Pounds-force inches (lbf in; lb in)
Pounds-force inches (lbf in; lb in)	x 0.113 = Newton metres (Nm)	x 8.85 = Pounds-force inches (lbf in; lb in)
Pounds-force inches (lbf in; lb in)	x 0.083 = Pounds-force feet (lbf ft; lb ft)	x 12 = Pounds-force inches (lbf in; lb in)
Pounds-force feet (lbf ft; lb ft)	x 0.138 = Kilograms-force metres (kgf m; kg m)	x 7.233 = Pounds-force feet (lbf ft; lb ft)
Pounds-force feet (lbf ft; lb ft)	x 1.356 = Newton metres (Nm)	x 0.738 = Pounds-force feet (lbf ft; lb ft)
Newton metres (Nm)	x 0.102 = Kilograms-force metres (kgf m; kg m)	x 9.804 = Newton metres (Nm)

Power

Horsepower (hp)	x 745.7 = Watts (W)	x 0.0013 = Horsepower (hp)
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Velocity (speed)

Miles per hour (miles/hr; mph)	x 1.609 = Kilometres per hour (km/hr; kph)	x 0.621 = Miles per hour (miles/hr; mph)
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Fuel consumption*

Miles per gallon, Imperial (mpg)	x 0.354 = Kilometres per litre (km/l)	x 2.825 = Miles per gallon, Imperial (mpg)
Miles per gallon, US (mpg)	x 0.425 = Kilometres per litre (km/l)	x 2.352 = Miles per gallon, US (mpg)

Temperature

Degrees Fahrenheit = (°C x 1.8) + 32	Degrees Celsius (Degrees Centigrade; °C) = (°F - 32) x 0.56
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* It is common practice to convert from miles per gallon (mpg) to litres/100 kilometres (l/100km), where mpg x 1/100 km = 282

Notes

Chapter 1

An introduction to the diesel engine

Contents

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		Future developments	

1 History

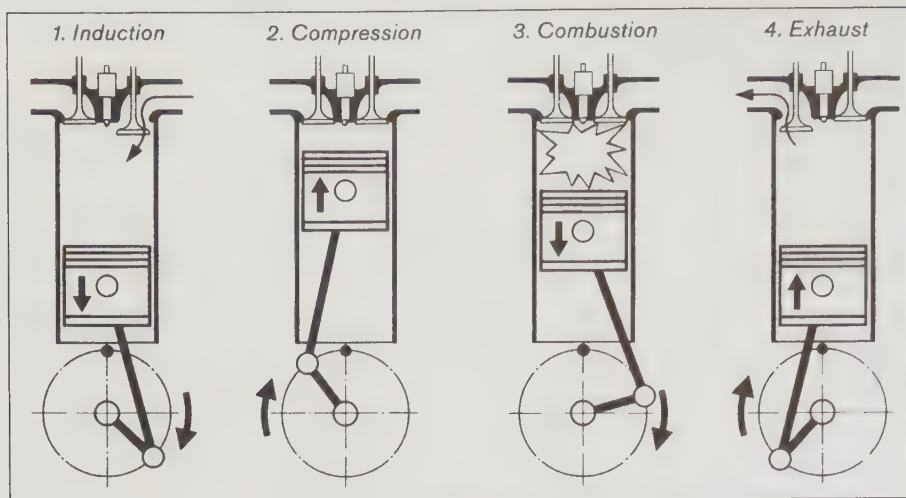
Rudolf Diesel invented the first commercially-successful compression-ignition engine at the end of the 19th century. Compared with the spark ignition engine, the diesel had the advantages of lower fuel consumption, the ability to use cheaper fuel, and the potential for much higher power outputs. Over the following two or three decades, such engines were widely adopted for stationary and marine applications, but the fuel injection systems used were not capable of high-speed operation. This speed limitation, and the considerable weight of the air compressor needed to operate the injection equipment, made the first diesel engines unsuitable for use in road-going vehicles.

In the 1920s, the German engineer Robert Bosch developed the in-line injection pump, a device which is still in extensive use today. The use of hydraulic systems to pressurise and inject the fuel did away with the need for a separate air compressor, and made possible much higher operating speeds. The so called 'high-speed' diesel engine became increasingly popular as a power source for goods and public transport vehicles, but for a number of reasons (including specific power output, flexibility and cheapness of manufacture), the spark-ignition engine continued to dominate the passenger car and light commercial market.

In the 1950s and 60s, diesel engines became increasingly popular for use in taxis and vans, but it was not until the sharp rises in oil prices in the 1970s that serious attention was paid to the small passenger car market. VW's introduction of the diesel-powered Golf at the end of 1977 marked the arrival of the

first 'user/friendly' diesel car, designed specifically to be acceptable to drivers who would not previously have considered abandoning the petrol engine. The diesel engine fitted to the Golf used indirect injection and a distributor type pump, and was comparable in performance to the smaller petrol engines fitted to the range.

Subsequent years have seen the growing popularity of the small diesel engine in cars and light commercial vehicles, not only for reasons of fuel economy and longevity, but also for environmental reasons. Every major European car manufacturer now offers at least one diesel-engined model. The diesel's penetration of the UK market has been relatively slow (due in part to the lack of any considerable fuel price differential in favour of diesel which exists in other parts of Europe), but it has now gained widespread acceptance, and this trend looks set to continue.



2.1 Four-stroke diesel cycle

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2 Principles of operation

1 All the diesel engines covered in this book operate on the familiar four-stroke cycle of induction, compression, combustion and exhaust (**see illustration**). (Two-stroke diesels do exist, and may in future become important, but they are used in few light vehicles at present.) Most have four cylinders, some larger engines have six, and five- and three-cylinder engines also exist.

Induction and ignition

2 The main difference between diesel and petrol engines is the means by which the fuel/air mixture is introduced into the cylinder and then ignited. In the petrol engine, the fuel is mixed with the incoming air before it enters the cylinder, and the mixture is then ignited at the appropriate moment by a spark plug. At all conditions except full-throttle, the throttle butterfly restricts the airflow, and cylinder filling is incomplete.

3 In the diesel engine, air alone is drawn into the cylinder and then compressed. Because of the diesel's high compression ratio (typically 20:1), the air gets very hot when compressed – up to 750°C (1382°F). As the piston approaches the end of the compression stroke, fuel is injected into the combustion chamber under very high pressure, in the form of a finely-atomised spray. The temperature of the air is high enough to ignite the injected fuel as it mixes with the air. The mixture then burns and provides the energy which drives the piston downwards on the combustion (power) stroke.

4 When starting the engine from cold, the temperature of the compressed air in the cylinders may not be high enough to ignite the

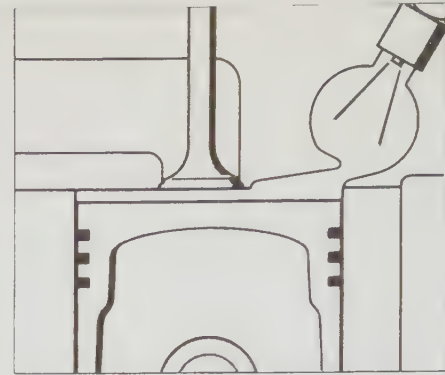
fuel. The preheating system overcomes this problem. Most modern engines have automatically-controlled preheating systems, using electric heater plugs (glow plugs) which heat the air in the combustion chamber just before and during start-up. Full details of these systems are given in Chapter 3.

5 On most diesel engines there is no throttle valve in the inlet tract; exceptions to this are those few engines which use a pneumatic governor, which depends on a manifold depression being created. Even more rarely, a throttle valve may be used to create manifold depression for the operation of a brake servo, though it is more usual for a separate vacuum pump to be fitted for this purpose.

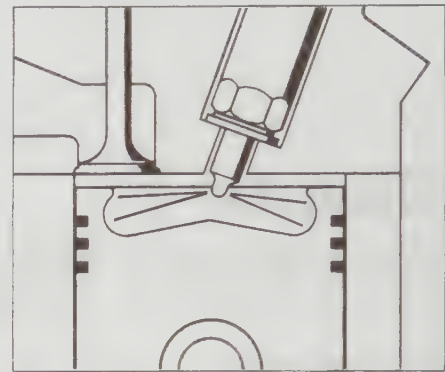
Direct and indirect injection

6 In practise, it is difficult to achieve smooth combustion in a small-displacement engine by injecting the fuel directly into the combustion chamber. To get around this problem, the technique of indirect injection is widely used. With indirect injection, the fuel is injected into a pre-combustion or 'swirl' chamber in the cylinder head, alongside the main combustion chamber. During the compression stroke the compressed hot air is forced into the swirl chamber where it enters a rapid swirling motion; fuel is injected into the swirl chamber, where it mixes with the rapidly moving air, enabling smoother combustion in the main combustion chamber (**see illustration**).

7 Generally speaking, indirect injection engines are less efficient than direct injection engines, and also require more preheating when starting from cold, but these disadvantages are offset by smoother and quieter operation. Until recently, direct injection engines were mostly fitted to light commercial vehicles, where increased noise and harshness are considered acceptable trade-offs for improved fuel economy.



Indirect injection into a swirl chamber



Direct injection

2.6 Indirect and direct injection

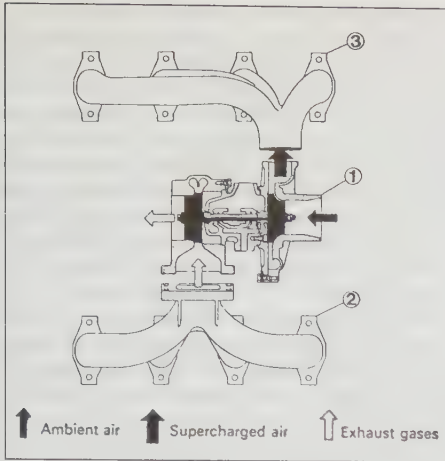
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Recently, the use of electronic diesel engine control systems has allowed the development of more refined direct injection engines, and their use in passenger vehicles is becoming more widespread.

Mechanical construction

8 Due to the high compression ratio required in a diesel engine, and the combustion characteristics, it is necessary to ensure that the lower face of the cylinder head is flat. This is achieved by positioning the valves vertically in the cylinder head (ie, with their stems at right-angles to the cylinder head lower face), and machining the combustion chambers directly into the tops of the pistons. Locating the combustion chambers in the pistons also enables the combustion process to be contained, and allows fine control of the combustion chamber size and shape during manufacture (all the combustion chambers in a diesel engine must be of similar size and shape).

9 The pistons, crankshaft and bearings of a diesel engine are generally of more robust construction than in a petrol engine of comparable size, because of the greater loads imposed by the higher compression ratio and



2.10 Principle of turbocharging

- 1 Turbocharger
- 2 Exhaust manifold
- 3 Inlet manifold

the nature of the combustion process. This is one reason for the diesel engine's longer life. Other reasons include the lubricating qualities of diesel fuel on the cylinder bores, and the fact that the diesel engine is generally lower-revving than its petrol counterpart, having much better low-speed torque characteristics and a lower maximum speed.

Turbocharging

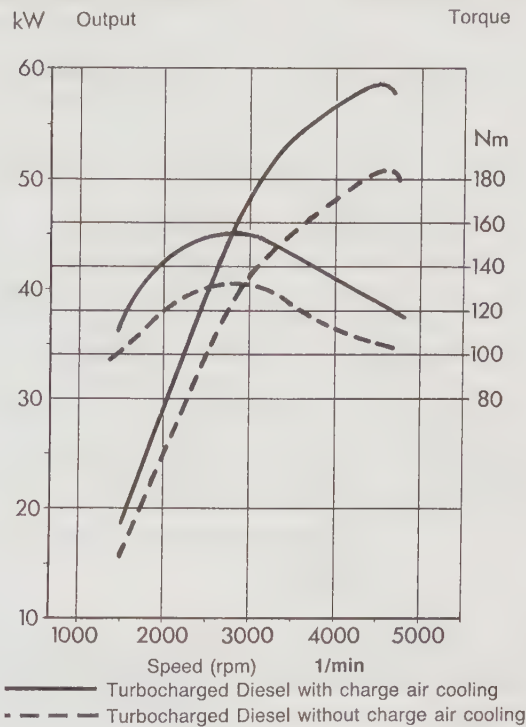
10 Turbochargers have long been used on large diesel engines, and are becoming common on small ones. The turbocharger uses the energy of the escaping exhaust gas to drive a turbine which pressurises the air in the inlet manifold. The air is forced into the cylinders instead of being simply sucked in. If more air is present, more fuel can be burnt and more power can be developed from the same size engine (see illustration).

11 Greater benefit can be gained from turbocharging if the pressurised air is cooled before it enters the engine. This is done using an air-to-air heat exchanger called an intercooler. The cooled air is denser and contains more oxygen in a given volume than warm air straight from the turbocharger (see illustrations).

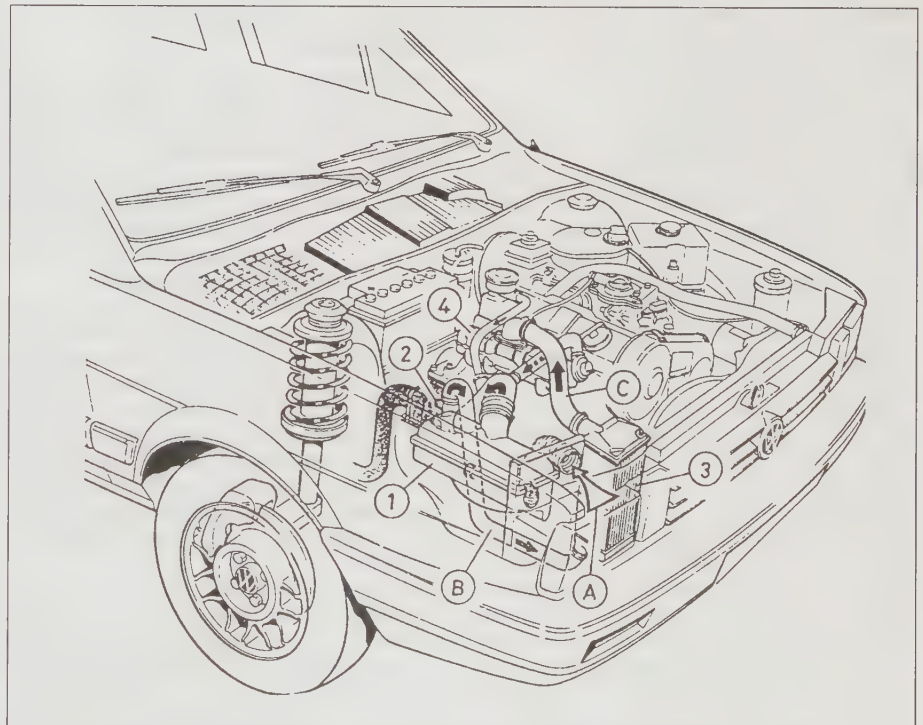
Exhaust emissions

12 Because combustion in a correctly-functioning diesel engine nearly always occurs in conditions of excess oxygen, there is little or no carbon monoxide (CO) present in the exhaust gas. A further environmental benefit is that there is no added lead in diesel fuel.

13 For many years, there was no need for complicated emission control systems on diesel engines. In the last few years however, simple catalytic converters, and exhaust gas recirculation systems, have become standard on most diesel engines in order to meet the increasingly stringent emission regulations.



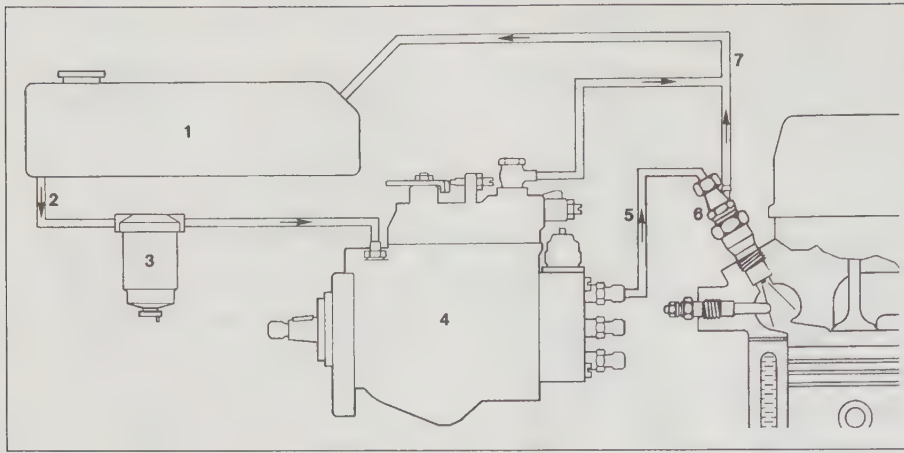
2.11a Power and torque outputs from a turbocharged engine with and without charge air cooling



2.11b Induction airflow in a turbocharged engine with charge air cooling

- 1 Air cleaner
- 2 Turbocharger
- 3 Intercooler
- 4 Inlet manifold

- A Inducted air
- B Compressed air before cooling
- C Compressed air after cooling



3.2 Fuel circulation – typical passenger car system

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- | | | |
|--------------------------|---|-------------------------------|
| 1 Fuel tank | 4 Injection pump with
integral supply pump | 6 Injector |
| 2 Fuel feed line | 5 Injector pipe | 7 Fuel return (leak-off) line |
| 3 Fuel filter/water trap | | |

The advent of electronic diesel engine control systems has also helped to improve diesel engine emissions.

Knock and smoke

14 The image of the diesel engine for many years was of a noisy, smoky machine, and to some extent this was justified. It is worth examining the causes of knock and smoke, both to see how they have been reduced in modern engines, and to understand what causes them to get worse.

15 There is inevitably a small delay (typically 0.001 to 0.002 second) between the start of fuel injection and the beginning of combustion. This delay, known as ignition lag, is greatest when the engine is cold and idling. The characteristic diesel knock is caused by the sudden increase in cylinder pressure which occurs when the injected fuel has been mixed with the hot air and starts burning. It is therefore an unavoidable part of the combustion process, though it has been greatly reduced by improvements in combustion chamber and injection system design. A defective injector (particularly one which is not atomising the fuel as it should for optimum combustion) will also cause the engine to knock.

16 Smoke is caused by incorrect combustion, but unlike knock it is more or less preventable. During start-up and warm-up a certain amount of white or blue smoke may be seen, but under normal running conditions the exhaust should be clean. The thick black smoke which is all too familiar from old or badly-maintained vehicles is caused by a lack of air for combustion, either because the air intake is restricted (clogged air cleaner), or because too much fuel is being injected (defective injectors or pump). Causes of smoke are examined in more detail in Chapter 9.

3 Fuel supply and injection systems

1 Fuel injection systems and components are covered in detail in Chapter 2. This Section gives an overview of the systems used, and their basic principles of operation.

Fuel supply

2 The fuel supply system is concerned with delivering clean fuel, free of air, water or other contaminants, to the injection pump. It always includes a fuel filter and a water trap (which may be combined in one unit), a fuel tank, and the associated pipework. Some arrangement must also be made for returning excess fuel from the fuel injectors and the fuel injection pump to the tank (see illustration).

3 On older vehicles which use an in-line injection pump, or where the fuel tank outlet is significantly lower than the injection pump, a fuel lift pump is used between the tank and the filter. When a distributor injection pump is fitted, and the tank outlet is at about the same level as the injection pump (as is the case with most passenger cars), a separate lift pump is not fitted. In this case, a hand-priming pump is often provided for use when bleeding the fuel system.

4 Additional refinements may be encountered. These include a fuel heater, which may be integral with the filter, or between the tank and the filter, to prevent the formation of wax crystals in the fuel in cold weather. On some vehicles, a 'water-in-fuel' warning light may be illuminated by a device in the water trap when the water reaches a certain level.

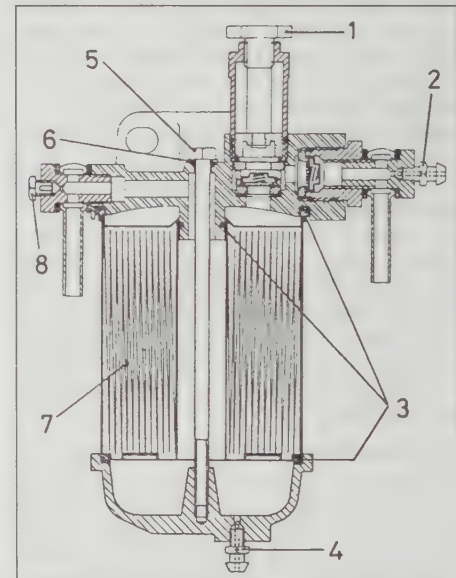
5 The water trap and fuel filter are vital for satisfactory operation of the fuel injection system. On some vehicles, the water trap may

have a glass bowl, in which case water build-up can be seen, or it may as already mentioned have some electrical device for alerting the driver to the presence of water. Whether or not these features are present, the trap must be drained at specific intervals, or more frequently if experience shows this to be necessary. If water enters the injection pump it can cause rapid corrosion, especially if the vehicle is left standing for any length of time.

6 The fuel filter may be of the disposable cartridge type, or it may consist of a renewable element inside a metal bowl (see illustration). Sometimes a coarser pre-filter is fitted upstream of the main filter. Whatever the type, it must be renewed at the specified intervals. Considering the damage which can be caused to the injection equipment by the entry of even small particles of dirt, it is not worth using cheap replacement filters, which may not be of the same quality as those of reputable manufacture.

Fuel injection pump

7 In a conventional diesel injection system, the pump is a mechanical device attached to the engine, driven at half-engine speed by a chain, gears or toothed belt. Its function is to supply fuel to the injectors at the correct pressure, at the correct moment in the combustion cycle, and for the length of time necessary to ensure efficient combustion. The pump responds to depression of the accelerator pedal by increasing fuel delivery, within the limits allowed by the governor. It is



3.6 Sectional view of a typical fuel filter

- | |
|--------------------------------------|
| 1 Hand-priming plunger |
| 2 Fuel bleed screw (on outlet union) |
| 3 Seals |
| 4 Water drain tap |
| 5 Through-bolt |
| 6 Through-bolt seal |
| 7 Filter element |
| 8 Air bleed screw (on inlet union) |

also provided with some means of cutting off fuel delivery when it is wished to stop the engine.

8 There are two basic types of pump; the in-line pump, generally fitted to larger engines, and the distributor pump, commonly fitted to passenger car engines. The in-line pump has one pump plunger per engine cylinder. The distributor pump, as its name implies, has a single pump plunger and directs its output to each cylinder in turn (see illustrations).

9 Some kind of governor is associated with the injection pump, either integral with it or attached to it. All vehicle engine governors regulate the fuel delivery to control idle speed and maximum speed; the variable-speed governor also regulates the intermediate speeds. Operation of the governor may be mechanical or hydraulic, or it may be controlled by manifold depression.

10 Other devices in, or attached to, the pump include cold start injection advance or fast idle units, turbo boost pressure sensors, and anti-stall mechanisms.

11 Fuel injection pumps are normally very reliable. If they are not damaged by dirt, water

or unskilled adjustment, they may well outlast the engine to which they are fitted.

12 Some modern electronically-controlled diesel injection systems use alternatives to the conventional in-line or distributor fuel pumps – brief details are given in Section 4, with a more detailed description in Chapter 2.

Fuel injectors

13 One fuel injector is fitted to each cylinder. The function of the injector is to spray an evenly-atomised quantity of fuel into the combustion or pre-combustion chamber when the fuel pressure exceeds a certain value, and to stop the flow of fuel cleanly when the pressure drops. Atomisation is achieved by a spring-loaded needle which vibrates rapidly against its seat when fuel under pressure passes it. The needle and seat assembly together are known as the injector nozzle.

14 Injectors in direct injection engines are

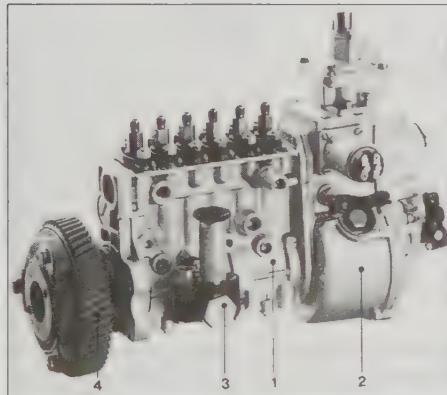
usually of the multi-hole type, while those in indirect engines are of the pintle type. The 'throttled pintle' injector gives a progressive build-up of injection, which is valuable for achieving smooth combustion (see illustrations).

15 The injector tips are exposed to the temperatures and pressures of combustion, so not surprisingly they will in time suffer from carbon deposits and ultimately from erosion and burning. Service life will vary according to factors such as fuel quality and operating conditions, but typically one could expect to clean and recalibrate a set of injectors after about 50 000 miles (80 000 km), and perhaps to renew them or have them reconditioned after 100 000 miles (161 000 km).

16 Some modern electronically-controlled diesel injection systems use electronically-controlled injectors – brief details are given in Section 4, with a more detailed description in Chapter 2.

Injector pipes

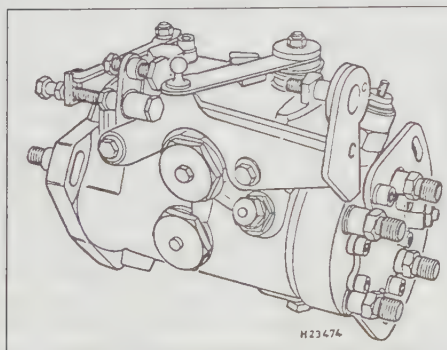
17 The injector pipes are an important part of the system, and must not be overlooked. The dimensions of the pipes are important, and it should not be assumed that, just because the end fittings are the same, a pipe from a



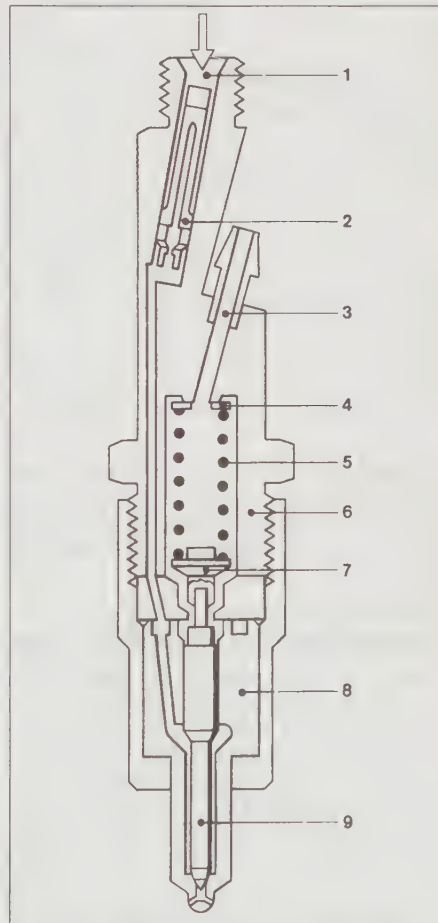
3.8a Bosch PE in-line injection pump and associated components

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- 1 Pump
- 2 Governor housing
- 3 Lift pump
- 4 Drivegear and advance mechanism



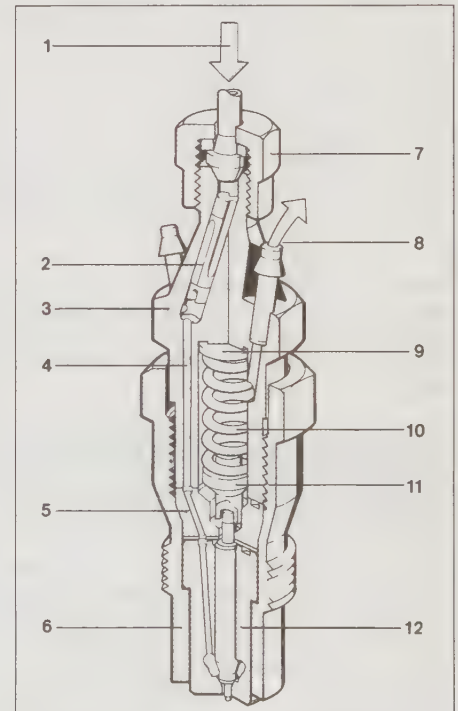
3.8b Lucas/CAV DPC-type distributor injection pump



3.14a Sectional view of a multi-hole injector

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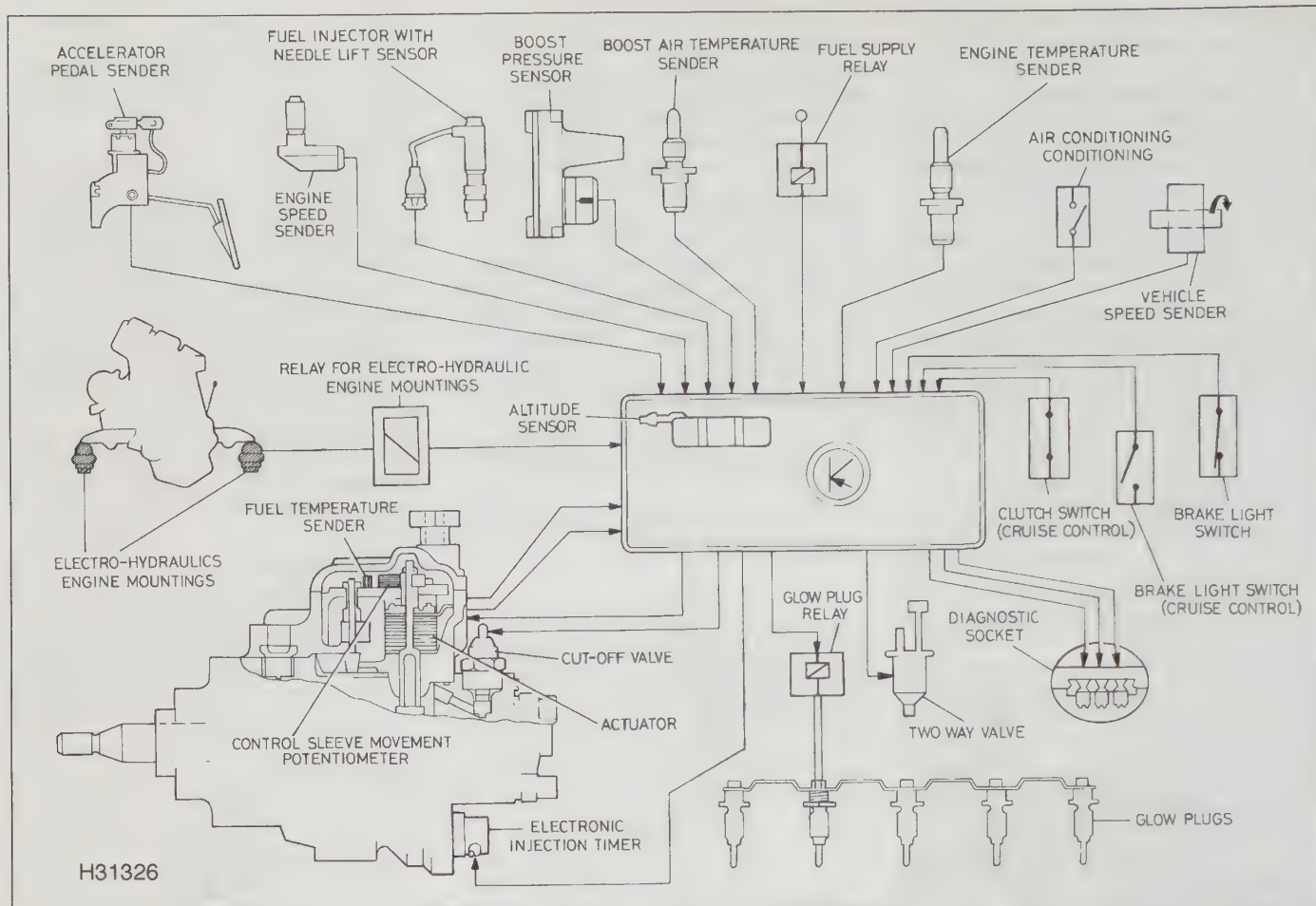
- | | |
|---------------------------|-----------------|
| 1 Fuel inlet | 5 Spring |
| 2 Integral filter | 6 Body |
| 3 Fuel return | 7 Spindle |
| 4 Pressure adjusting shim | 8 Nozzle body |
| | 9 Nozzle needle |



3.14b Cutaway view of a pintle injector

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- | | |
|--------------------|---------------------------|
| 1 Fuel inlet | 8 Fuel return |
| 2 Integral filter | 9 Pressure adjusting shim |
| 3 Body | 10 Spring |
| 4 Pressure passage | 11 Spindle |
| 5 Sleeve | 12 Nozzle |
| 6 Nozzle retainer | |
| 7 Union nut | |



4.4 Electronic diesel control system components fitted to an Audi 2.5 litre engine

different engine can be used as a replacement. Securing clips must be kept tight, and the engine should not be run without them, as damage from vibration or fuel cavitation may result.

4 Electronic diesel engine control systems

1 Development of the diesel engine, and particularly the fuel injection system, has been relatively slow compared with the advances which have been made in petrol engine fuel injection and management systems. However, in recent years, electronic diesel engine control systems have been developed to improve diesel engine efficiency and to reduce exhaust emissions. Almost all modern engines use some form of electronic engine control system.

2 For a diesel engine to operate efficiently, it is essential that the correct amount of fuel is injected at the correct pressure, and at exactly the right time. Even small deviations can cause increased exhaust emissions,

increased noise, and increased fuel consumption. In a typical diesel engine, the injection process takes only a thousandth of a second, and only a minute quantity of fuel is injected.

Electronic control using a conventional fuel injection pump

3 As we've already seen, the function of the fuel injection pump is to supply fuel to the injectors at the correct pressure, at the correct moment in the combustion cycle, and for the length of time necessary to ensure efficient combustion. A conventional (mechanically-controlled) fuel injection pump uses an accelerator cable (connected to the driver's accelerator pedal), and various mechanical add-on devices (such as cold start injection advance, fast idle units, turbo boost pressure sensors, etc) to provide control of the fuel injection timing and the quantity of fuel injected. Even with these add-on devices, it has become increasingly difficult for a mechanical diesel control system to keep pace with modern demands on engine refinement and exhaust emission control.

4 Many electronic diesel engine control systems use a conventional in-line or distributor fuel injection pump, but the injection pump timing and the quantity of fuel injected are controlled electronically instead of mechanically. Various electronic sensors are used to measure variables such as accelerator pedal position, engine crankshaft speed, engine camshaft position, the mass of air passing into the engine, turbocharger boost pressure, engine coolant temperature, ambient air temperature, etc (**see illustration**).

5 The information from the various sensors is passed to an electronic control unit (ECU), which evaluates the signals. The ECU memory contains a series of mapped values for injected fuel quantity, and start-of-injection point. The ECU performs a number of calculations based on the information provided by the sensors, and selects the most appropriate values for the fuel quantity and start-of-injection point from its stored values. The ECU is capable of analysing the data and performing calculations many times per second, which allows very accurate control over the operation of the engine.

Common rail diesel injection systems

6 A recent development in electronic diesel engine control is the Common Rail diesel injection system. Common rail injection systems have been developed by several manufacturers for use on direct injection diesel engines.

7 The common rail system derives its name from the fact that a common rail, or fuel reservoir, is used to supply fuel to all the fuel injectors.

8 Common rail systems give very fine control of the engine, and allow the problems of increased noise and harshness often associated with direct injection engines to be greatly reduced. Further details of common

rail injection systems can be found in Chapter 2, Section 9.

'Pump injector' diesel injection systems

9 The 'pump injector' system uses a combined injection pump/injector for each engine cylinder. This eliminates the need for a separate high pressure injection pump, and the associated high pressure fuel lines.

10 As with common rail systems, pump injector systems give very fine control of the engine. Further details of pump injector systems can be found in Chapter 2, Section 10.

Future developments

11 Development of the diesel engine, and particularly the fuel injection system, has been relatively slow compared with the advances which have been made in petrol engine fuel injection and engine management systems. However, recent developments in electronic diesel control systems and the introduction of common rail and pump injector fuel systems have closed the performance and refinement gap between diesel and petrol engines.

12 There can be no doubt that the current combination of high fuel prices and increased environmental awareness, along with the increase in diesel engine vehicle sales, will provide the stimuli for further improvements in the future.

Notes

Chapter 2

Fuel injection systems

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1 Introduction

A brief description of the fuel supply and injection systems in use on diesel engines was given in Chapter 1. The various systems which may be encountered will now be described in more detail. Later Chapters deal with maintenance, testing, adjustment and overhaul procedures.

2 Diesel fuel

Unlike petrol, diesel fuel must be capable of igniting under high pressure in hot air, without the aid of an electrical spark.

Diesel fuel is distilled from crude oil, and contains a percentage of oil-based compounds which are not present in petrol. The oil-based compounds give diesel fuel lubricating qualities, which eliminates the need for separate lubricating oil to protect the moving components in a fuel injection pump. Diesel fuel is less volatile than petrol, which reduces the risk of fire during storage and handling.

There are however a few disadvantages associated with diesel fuel. Firstly, the high sulphur content of the fuel makes a diesel engine more prone to deposits of carbon and other combustion products on the piston rings and contact surfaces of the pistons; this is usually combated by using engine lubricating oils with detergent additives. Secondly, diesel fuel is prone to 'waxing' in cold weather, as some of the large hydrocarbon molecules join together to form

paraffin wax compounds; if the temperature falls sufficiently, the fuel becomes so full of wax that it will no longer flow. To reduce the likelihood of waxing, fuel companies normally change the composition of diesel fuel during the winter months, and vehicle manufacturers often fit a fuel heater in the fuel line between the fuel tank and the filter.

Although diesel engine vehicles have less of a direct impact on the environment than their petrol engine counterparts, the fact that diesel fuel is distilled from the same raw crude oil as petrol means that as the reserves of natural crude oil are exhausted, both petrol and diesel fuel supplies will run out. However, currently a number of manufacturers are carrying out research into adapting diesel engines to run on alternative fuels (modified diesel engines have been run successfully using alcohol, and even rape-seed oil-based fuels).

3 Fuel supply system

Fuel lift pumps

Engines with distributor fuel injection pump

1 As mentioned in Chapter 1, a separate fuel lift pump is not normally fitted to passenger cars using a distributor type fuel injection pump. The transfer pump built into the injection pump provides enough suction to draw the fuel from the tank.

2 One effect of not using a separate lift pump is that the fuel supply lines are always under negative pressure while the engine is running. The slightest leak at any unions or seals will allow air to be drawn in, with adverse effects on the running of the engine.

3 The transfer pump also has to overcome the resistance to flow caused by the fuel filter. For this reason, the effects of filter clogging are more pronounced, and filter life is generally less than when a separate lift pump is used.

Engines with in-line fuel injection pump

4 The in-line injection pump requires fuel to be supplied at a pressure of approximately 1 bar, so a separate lift pump is always used (see illustration). The lift pump may be of the diaphragm or piston type; it may be driven from the injection pump or directly from the engine. In any case, it is fitted between the fuel tank and the fuel filter. The fuel supply lines between the lift pump and the injection pump are under low pressure while the engine is running, so leakage will not result in air being drawn in, but in fuel leaking out.

Engines with common rail fuel injection system

5 In a common rail fuel injection system, a separate lift pump is used to pump fuel from the tank to the high-pressure pump, via the fuel filter. There are several different types of fuel lift pump in use on common rail systems, but the two most common are the roller-cell electric type (often submerged in the fuel tank), and the engine-driven gear type. The fuel supply lines between the lift pump and the high-pressure pump are under low pressure while the engine is running, so leakage will not result in air being drawn in, but in fuel leaking out.

Engines with 'pump injector' injection system

6 In a 'pump injector' fuel injection system, a separate lift pump is used to pump fuel from the tank to the injectors, via a fuel filter. The VW system uses a vane-type fuel lift pump, driven from the engine camshaft. The fuel supply lines between the lift pump and the injectors are under low pressure while the engine is running, so leakage will not result in air being drawn in, but in fuel leaking out.

Fuel filter and water trap

7 On most passenger vehicles, the fuel filter and water trap are combined into one unit. Some light commercial and many off-road vehicles have a separate water trap and/or pre-filter (see illustration).

8 The water trap is necessary because water vapour from the atmosphere can condense in diesel fuel storage tanks (or even in the vehicle's fuel tank if it is left standing for a long time). This does not happen to the same extent in petrol storage tanks because of the higher vapour pressure of petrol.

9 In practise, water may rarely be found in the trap of a vehicle in regular use, as long as fuel

is being purchased from a reputable source with a good turnover. This should not be taken as a reason to neglect periodic draining of the trap, unless a 'water-in-fuel' warning light is fitted.

10 The fuel filter is vital to the correct functioning and long life of the fuel injection system components. A clogged filter will reduce performance, and (through its effect on system pressure) can cause smoking and erratic running on some engines. A filter which allows particles of dirt to pass will cause early failure of an injection pump.

Bleeding air from the fuel supply system

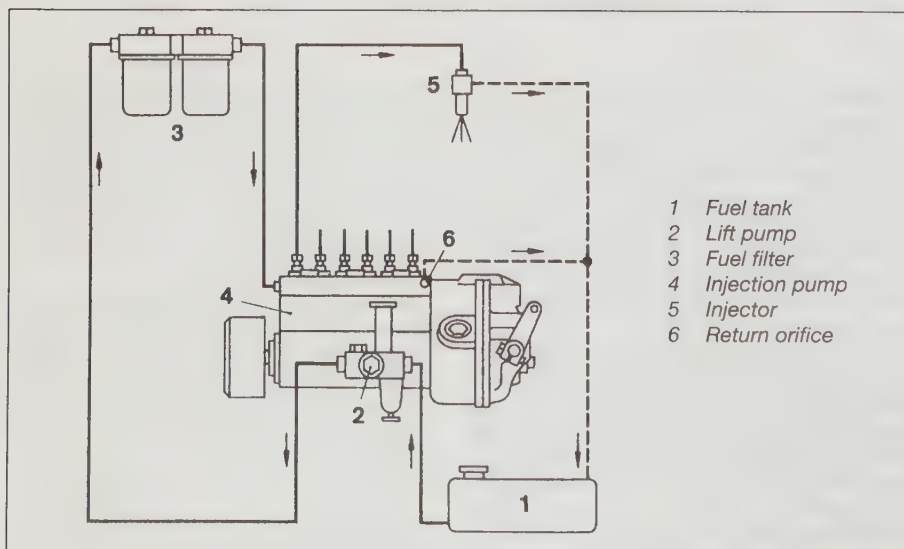
11 On all systems, it is necessary to stop air entering the fuel supply lines, and to bleed out air which enters during maintenance and repair work. Methods of bleeding are described in Chapter 8.

12 On systems using a separate lift pump, a self-bleeding facility can be provided by the fuel return system, using overflow valves or restrictors on the injection pump and/or filter (see illustration). When the pump is operating, a proportion of the fuel pumped is returned to the tank by the valves or restrictors; because they are at the highest point of the filter head or pump, air or fuel vapour bubbles automatically go into the return line to the tank.

13 The distributor type pump is also self-bleeding via its fuel return orifice, but the orifice is relatively small, and cannot handle large quantities of air in the fuel. Most common rail and 'pump injector' systems are self-bleeding.

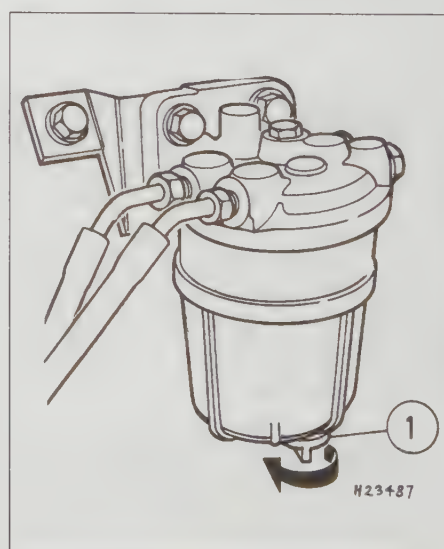
Low temperature operation

14 As mentioned in Section 2, when diesel fuel is subjected to low temperatures, some of the hydrocarbon molecules join together to form



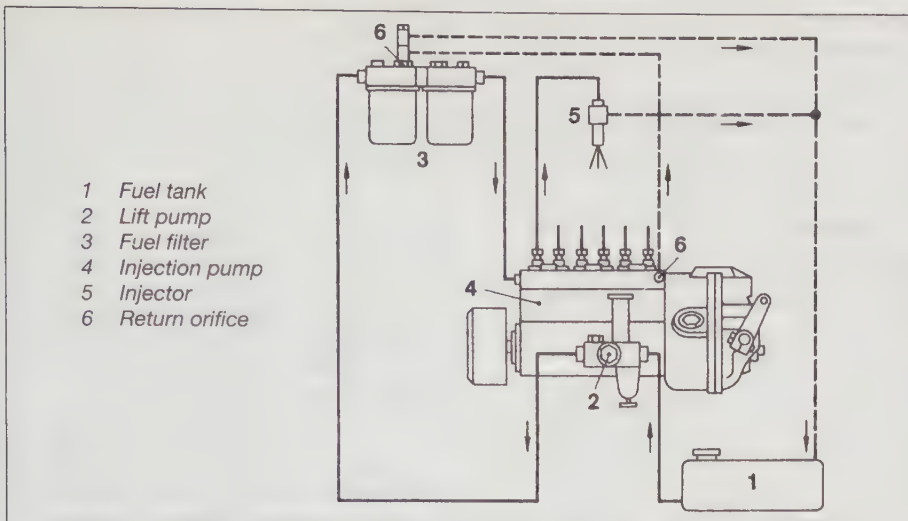
3.4 Fuel supply and return lines – in-line pump with lift pump

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3.7 Water trap fitted to a Range Rover

1 Drain screw



3.12 Fuel supply and return lines – in-line pump with self-bleeding fuel system

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paraffin wax compounds. This causes the fuel to become cloudy in appearance. The temperature at which this happens is known as the *cloud point*; the fuel will still flow satisfactorily, and the engine will still run normally.

15 If the temperature falls further, the wax compounds combine, and present an increased resistance to flow. Eventually, the fuel will no longer flow, having a consistency similar to cold custard. The temperature at which this happens is known as the *pour point*. Obviously, if the fuel will not flow from the tank, the engine will not run at all. To get rid of these wax compounds completely, the fuel has to be raised to a much higher temperature than that at which the compounds formed.

16 In practise, problems start at a temperature between the cloud point and the pour point, when the wax compounds are not large enough to stop the fuel flowing from the tank, but are large enough to block the fine pores of the fuel filter element. This temperature is known as the *cold filter plugging point (CFPP)*.

17 When the cold filter plugging point has been reached, the engine may start normally but then stop almost immediately, or idle normally but refuse to speed up. If the filter can be warmed sufficiently to allow the fuel to flow freely, this will cure the problem, at least until the next cold start (**NEVER** use a naked flame for this – use a hair dryer or fan heater). In bad cases, it will be necessary to fit a new filter element. Once the engine has warmed up, the under-bonnet temperature is high enough to stop wax forming in the filter.

18 The oil companies alter the composition of the fuel in winter to reduce low-temperature problems. Winter-grade diesel fuel should be useable at temperatures well below freezing without extra additives or heating (the composition of winter fuel will vary depending on the country in which it is being used, and the temperatures likely to be encountered).

19 Fuel waxing obviously has a worse effect if the fuel filter element is not in good condition, and some manufacturers specify the renewal of the filter element at the

beginning of every winter, regardless of the mileage covered since the previous renewal.

Anti-waxing or anti-gel fuel additives

20 Fuel additives are available to lower the temperature at which filter plugging occurs, but not all vehicle manufacturers approve their use. The additive (which is added to the fuel tank) has to mix with the fuel *before* waxing occurs – it is no good trying to avoid it once the problem has already begun.

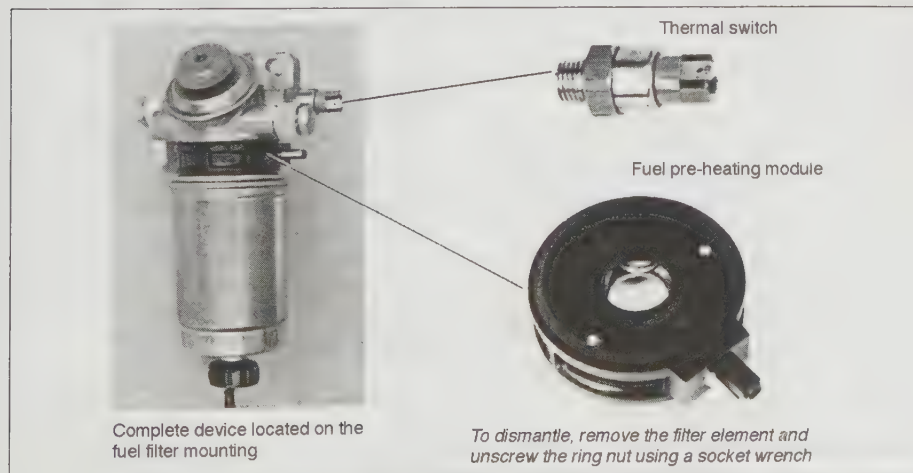
21 Protection against waxing can also be achieved by adding a proportion (typically 10 to 20%) of petrol or paraffin to the fuel. Some vehicle manufacturers recommend or tolerate this, while others forbid it. There is no doubt that the practise works, but there are various objections to it:

- A petrol/diesel mixture is more inflammable than plain diesel fuel, and gives off explosive vapour. If too much petrol is added, it will not mix with the diesel, but will float on top of it.*
- Combustion of a petrol/diesel mixture is not as smooth as combustion of pure diesel.*
- Petrol or paraffin will reduce the lubricating properties of the fuel, and perhaps cause accelerated injection pump wear.*
- Paraffin in the UK is not taxed as a road fuel, so its use in vehicle fuel tanks is an offence.*

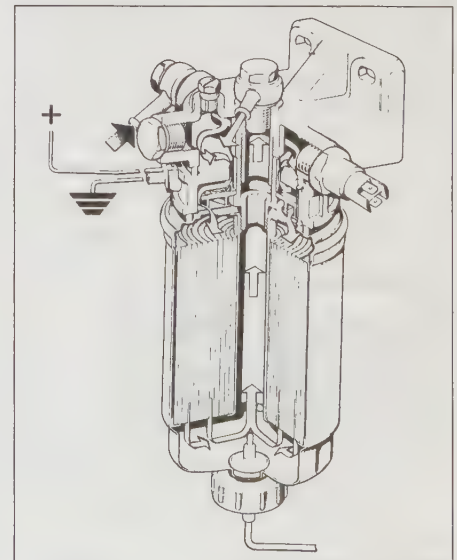
Fuel heaters

22 An alternative approach to fuel waxing problems is to heat the fuel before it arrives at the filter. Some vehicle manufacturers fit a fuel heater as standard, and heater kits are available from various manufacturers for aftermarket fitting.

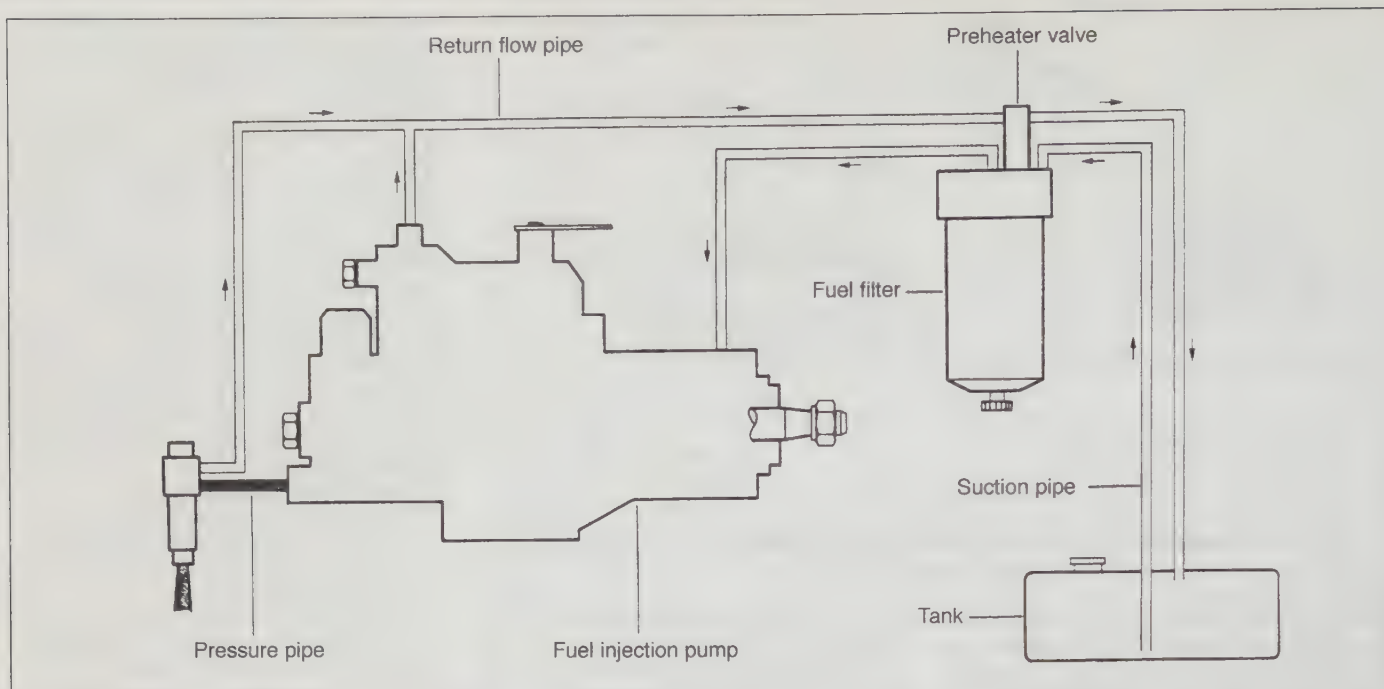
23 Some fuel heaters are electrically-operated, forming part of the filter head, or positioned between the fuel tank and filter (see illustrations). A thermostatic switch



3.23a Electrically-operated fuel heater incorporated in the filter head



3.23b Fuel flow through the filter and heater element



3.25a Fuel supply and return lines – VW self-heating system

ensures that the heater is only energised when the temperature is low. Generally, the heater is not energised until the ignition is switched on.

24 Other types of fuel heater use engine coolant as the heating medium – this will obviously not be effective if the temperature is already so low that the engine will not start.

25 The fuel heater fitted to later VW models diverts fuel from the return line back into the filter when the temperature is low (**see illustrations**). The fuel returning from the pump and injectors warms up rapidly once the engine is running, so provided the engine will start, plugging of the filter should not occur. VW claim that the use of this type of heater, in conjunction with appropriate winter-grade fuel, dispenses with the need for anti-

waxing additives down to -24°C . Some other manufacturers use a similar system on vehicles destined for cold climates.

4 Fuel injection pumps - general

1 The function of an injection pump is to supply fuel to the injectors at the correct pressure, at the correct moment in the combustion cycle, and for the length of time necessary to ensure efficient combustion.

2 Pump characteristics are carefully matched to a particular engine. This matching extends to the delivery valves, injector pipes and the injectors themselves. Substitution of any of these items with those from another engine or pump will not necessarily be successful, even if the substitute items have the same external dimensions.

3 The in-line pump was developed by Robert Bosch in the 1920s, and is still in use (with some refinements, but basically unchanged) to this day. On small passenger car engines, it has been largely superseded by the distributor pump, but it may still be found on some light commercial vehicles.

4 The distributor pump has a single high-pressure pump element. As the name implies, fuel under pressure is distributed to each injector in turn. The pump contains its own governor mechanism and lift pump.

Governors

5 All diesel fuel injection pumps have a governor, either mounted externally (in-line

pump) or built into the pump housing (distributor pump). The governor on a road-going vehicle engine always regulates idle speed and maximum speed.

6 Regulation is necessary because the fuel delivery from an ungoverned fuel injection pump varies more or less directly with engine speed. Engine speed, on the other hand, varies according to load and fuel delivery. At idle, an ungoverned engine would either slow down, so reducing fuel delivery, and stall; or it would speed up, increasing fuel delivery, and carry on doing so until a mechanical failure occurred.

7 Maximum speed regulation prevents the engine from being damaged by over-revving if its load is reduced or suddenly removed.

8 Some types of governor also control speeds in between idle and maximum. These are known as *variable-speed* or *all-speed* governors.

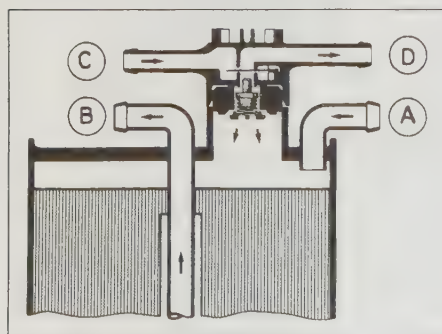
9 Additional features found on some governors include the control of starting fuel delivery (which may exceed normal full-load delivery) and varying full-load delivery in proportion to engine speed. This last feature is known as *torque control*.

10 The various governor types are described in more detail in the Sections dealing with the pumps to which they are fitted.

Torque control

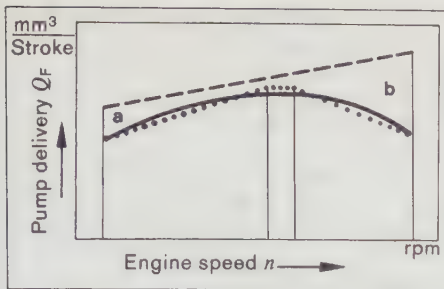
11 Torque control is the name given to systems which vary full-load fuel delivery according to engine speed, in order to match more closely the optimum fuel requirement.

12 The fuel requirement of a non-turbocharged engine reduces in its upper



3.25b Fuel flow through filter at low temperature – VW self-heating system

- A From fuel tank
- B To injection pump
- C Return from pump and injectors
- D Return to tank



4.16 Injection pump delivery with and without torque control – curve shows actual fuel requirement

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- a Negative torque control
- b Positive torque control
- Pump delivery without torque control
- ... Pump delivery with torque control

speed ranges, but fuel delivery from an injection system without torque control increases with speed.

13 If the pump is set to deliver the optimum amount of fuel at low speeds, too much will be delivered at high speeds, and the engine

will smoke or overheat. On the other hand, if the pump is set only to deliver the optimum amount of fuel for high speeds, less fuel will be delivered at low speeds than could be burnt, and the engine will not produce as much torque as it could.

14 To correct this situation, a system is needed which will reduce fuel delivery with increasing speed. This is known as *positive torque control*.

15 With turbocharged engines, the opposite situation can arise: at higher speeds, the fuel requirement rises faster than the pump output. In this case, fuel delivery must be increased with speed, and this is known as *negative torque control*.

16 In practise, an engine may need to be the subject of both positive and negative torque control in order to produce its optimum output over all speed ranges (see illustration).

17 Positive torque control can take place in the governor, or it can be a feature of pump delivery valve design. Negative torque control can only take place in certain types of governor. Both systems are described in more detail in the Sections dealing with the pumps to which they are fitted.

5 In-line injection pumps and governors

1 The function of a fuel injection pump is to supply fuel to the injectors at the correct pressure, at the correct moment in the combustion cycle, and for the length of time necessary to ensure efficient combustion.

2 Pump characteristics are carefully matched to a particular engine. This matching extends to the delivery valves, injector pipes and the injectors themselves. Substitution of any of these items with those from another engine or pump will not necessarily be successful, even if the substitute items have the same external dimensions.

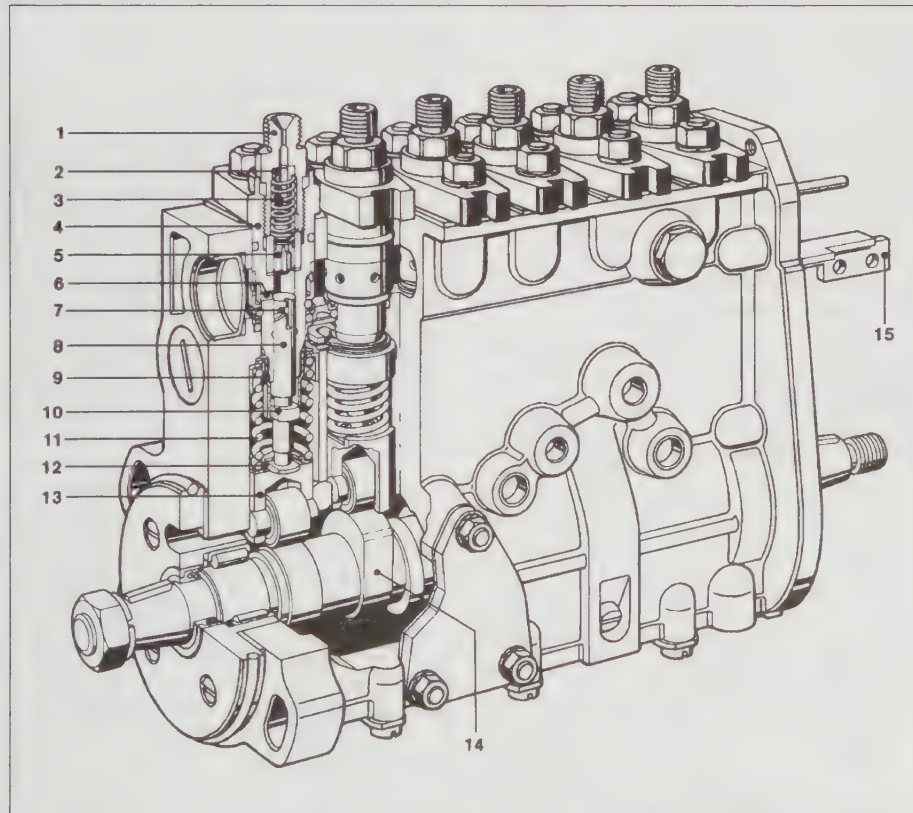
BOSCH PUMPS AND GOVERNORS

Bosch PE pump

Basic principles

3 The in-line pump is a series of separate single-plunger pumps (one per engine cylinder) contained in one housing, and with a shared control system (see illustration). A camshaft inside the pump is driven at half-engine speed by timing gears, a chain or a toothed belt. The cams operate the injection pump plungers via roller tappets. Spring-loading between the plungers and tappets keeps the latter in contact with the cams.

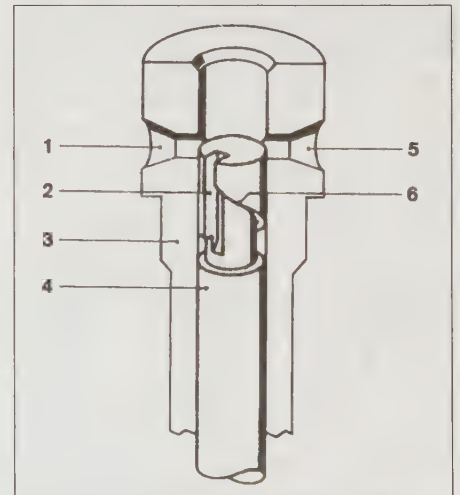
4 Each pump plunger works in a barrel (see illustration). Each barrel has at least one fuel delivery port. At the top of the barrel is a fuel delivery valve. The delivery valve is connected to a fuel pipe, the other end of which is connected to the relevant fuel injector.



5.3 Cutaway view of a Bosch PES in-line fuel injection pump

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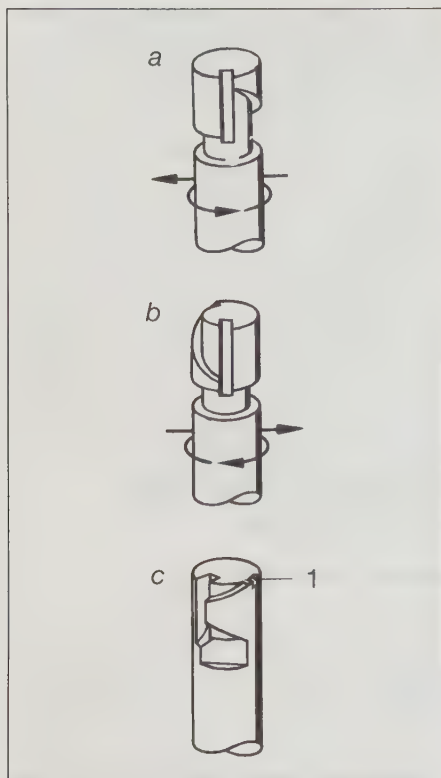
- | | | |
|-------------------------|--------------------|--------------------------|
| 1 Delivery valve holder | 6 Inlet/spill port | 11 Plunger return spring |
| 2 Spacer | 7 Helix | 12 Spring seat |
| 3 Spring | 8 Pump plunger | 13 Roller tappet |
| 4 Pump barrel | 9 Control sleeve | 14 Cam |
| 5 Delivery valve | 10 Control arm | 15 Control rod |



5.4 Bosch PE pump plunger and two-port barrel

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- | | |
|-------------------|--------------------|
| 1 Inlet port | 4 Plunger |
| 2 Vertical groove | 5 Inlet/spill port |
| 3 Barrel | 6 Helix |



5.10 Bosch PE pump plunger versions

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- a Lower helix
b Upper helix
c Upper and lower helix
1 Starting groove

Downward movement of the plunger allows the barrel to fill with fuel. Upward movement forces fuel under pressure out of the delivery valve and so into the injector.

5 The pump cams are arranged so that each plunger delivers fuel to the appropriate injector in the engine firing order. The cam profiles are also important in determining the

point at which injection starts, and its duration.

6 Lubrication of the camshaft, bearings and roller tappets is by connection to the engine's lubrication system. Lubrication of the high-pressure components is carried out by the fuel.

Plunger and barrel construction

7 The plunger and barrel are a matched assembly, made to very fine tolerances. Some leakage of fuel takes place between them, but this is an intentional feature of the design, and is necessary for lubrication. (This leaked fuel is returned to the suction side of the pump by a drilling in the barrel, so that it does not enter the engine oil and dilute it.) The barrel has one or two ports for fuel delivery and return (spill).

8 The bottom of the plunger is connected to a control sleeve. This sleeve can rotate the plunger while still allowing it to go up and down. All the control sleeves in the pump are connected to one control rod.

9 The plunger has a vertical groove machined on one side and extending to the top. In the simplest design, a single helical groove meets the vertical groove. When the plunger is rotated in the barrel, this changes the point in the plunger stroke at which the helical groove covers and uncovers the port.

10 Practical requirements in areas such as noise reduction, exhaust emission control and cold start characteristics mean that plungers typically have more than the two grooves just described, but the basic principle remains the same: by rotating the plunger in the barrel, both the amount of fuel injected and the moment at which injection occurs can be altered (see illustration).

The pump working cycle

11 The pump has a defined working cycle. The phases of the cycle are clearly shown (see illustration).

12 The first phase of the cycle is the *fuel inlet*. With the plunger at BDC, both inlet ports

are open, and fuel flows from the pump suction gallery into the barrel.

13 As the plunger rises in the barrel, the phase known as *prestroke* begins. Prestroke lasts until the plunger has closed off both inlet ports.

14 The plunger continues to rise, and the *retraction stroke* begins. During this phase, the fuel pressure is rising, but the delivery valve has not opened because the pressure is not great enough.

15 As soon as the delivery valve opens, the *effective stroke* begins. Movement of the plunger now forces fuel up the pipe to the injector, and fuel injection takes place. The amount of fuel delivered depends on the length of the effective stroke.

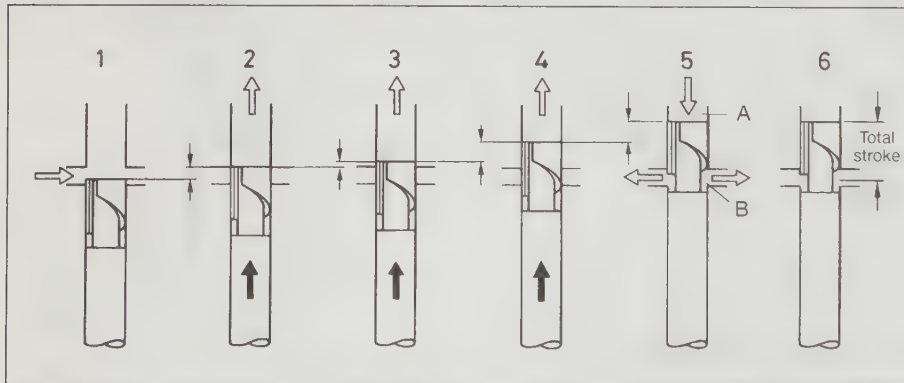
16 The end of the effective stroke occurs before TDC, when the helix uncovers an inlet port. The fuel under pressure spills out of the port, the delivery valve closes, and injection stops. The plunger carries on to TDC, and this is known as the *residual stroke*.

17 The plunger now returns to BDC, and the cycle begins again. On the way down, the plunger again covers both inlet ports, and during this phase of operation, a vacuum will be produced in the barrel until the inlet ports are uncovered and fuel can flow in.

Delivery valves

18 The delivery valve separates the pump barrel from the injector pipe. The valve only opens when the pressure in the barrel exceeds a certain value, and closes as soon as pressure begins to drop. This contributes to precise beginning and ending of injection.

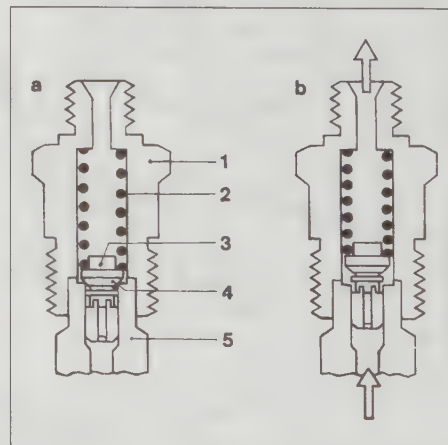
19 In its simplest form, the delivery valve consists of a spring-loaded plunger in a holder (see illustration). The size and shape of the plunger are matched to the length and diameter of the injector pipe. When the valve closes, the retraction of the plunger increases the effective volume of the fuel pipe by a



5.11 Bosch PE pump working cycle

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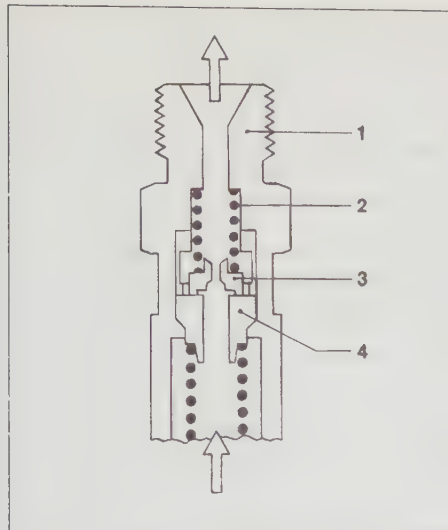
- | | | |
|---------------------|--------------------------------|-------------------|
| 1 BDC (fuel inlet) | 4 Effective stroke | A Plunger chamber |
| 2 Prestroke | 5 Residual stroke | B Suction gallery |
| 3 Retraction stroke | 6 TDC (end of residual stroke) | |



5.19 Delivery valve closed (a) and open (b)

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- | | |
|--------------|----------------|
| 1 Valve body | 4 Valve seat |
| 2 Spring | 5 Valve holder |
| 3 Plunger | |



5.21 Delivery valve with return-flow restrictor

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- | | |
|--------------|-------------------------------------|
| 1 Valve body | 3 Plate with return-flow restrictor |
| 2 Spring | 4 Valve holder |

calculated amount. This relieves the pressure in the pipe and makes the injector shut cleanly.

20 The delivery valve can also be part of a torque control system. (For an explanation of torque control, see Section 4.) This is done by profiling the plunger so that it offers a greater resistance to fuel flow at higher velocities.

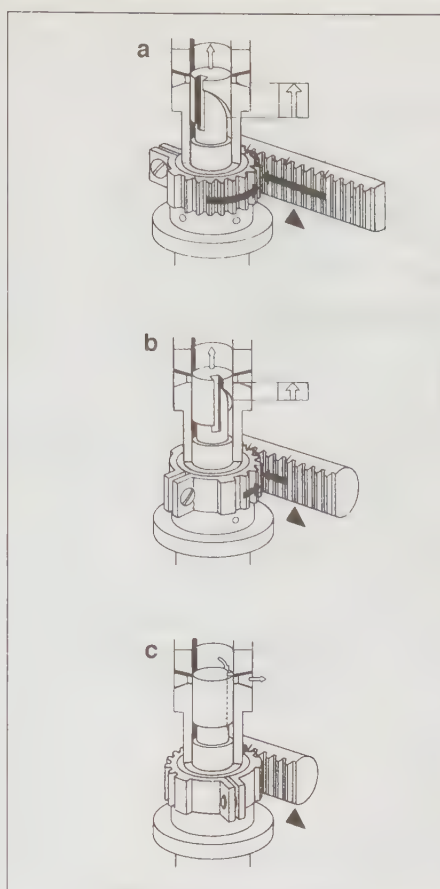
21 A further refinement, known as *return-flow restriction*, allows the delivery valve to play an important part in reducing turbulence and cavitation in the injector pipe. The return-flow restrictor valve sits on top of the delivery valve. It offers little resistance to fuel flow in the forward direction, but damps out the reverse-pulse which occurs when the injector needle snaps shut (see illustration).

Pump control

22 As mentioned earlier, the amount of fuel delivered is controlled by rotating the plunger in the barrel, so varying its effective stroke. The plunger is turned by a control sleeve. All the control sleeves are connected to one control rod, which is in turn connected to the governor. The rod may be connected to the sleeves by gear teeth (rack and pinion), or by slots and levers (see illustration).

23 If the plunger is turned so that its vertical groove is in line with a delivery port, the port will be exposed for the whole cycle, and no fuel delivery will take place. This position is selected when it is desired to stop the engine.

24 An adjustable stop may be fitted to the control rod, to limit its travel in the 'increased-delivery' direction, so limiting the maximum fuel delivery of the pump. Some engines require more fuel at start-up than at full-load,



5.22 Variation of fuel delivery

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- | |
|--------------------|
| a Maximum delivery |
| b Partial delivery |
| c Zero delivery |

and in this case, the stop is temporarily bypassed.

Governor types

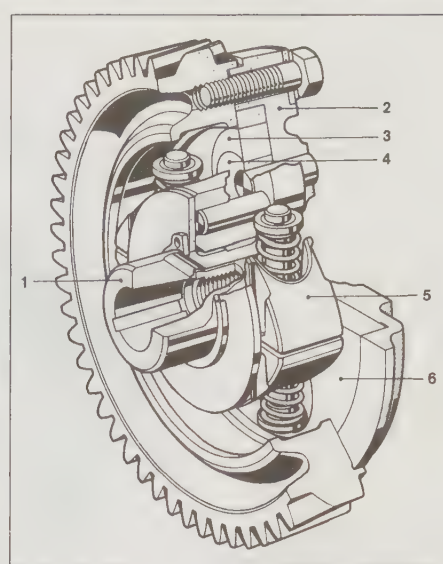
25 A centrifugal minimum-maximum type governor is usually fitted to this type of pump, though occasionally a pneumatic governor will be found. These are described later in this Section.

Timing mechanisms

26 A centrifugal advance device is incorporated in the pump drive, in order to advance injection timing with increased speed (see illustration).

Identification and detail differences

27 Pumps prefixed PE have a flat base or cradle mounting while those prefixed PES have an end flange mounting. Most pumps found on small and middle-sized engines will be type M (the smallest) or type A. Type MW and P pumps are of heavier construction, and capable of higher maximum pressures, but the principles of operation are the same.



5.26 Cutaway view of centrifugal advance coupling

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- | | |
|-----------------------|--------------------------|
| 1 Hub | 4 Compensating eccentric |
| 2 Housing | 5 Flyweight disc |
| 3 Adjusting eccentric | 6 Adjusting disc |

Governors fitted to Bosch PE pumps

Introduction

28 One of the following types of governor will be found fitted to every Bosch PE pump. The governors divide into two basic types: centrifugal and pneumatic. The centrifugal governors are all further subdivided according to their spring arrangements (incorporated into the weight assemblies, or remote), and according to their speed regulation range (idle/maximum or variable).

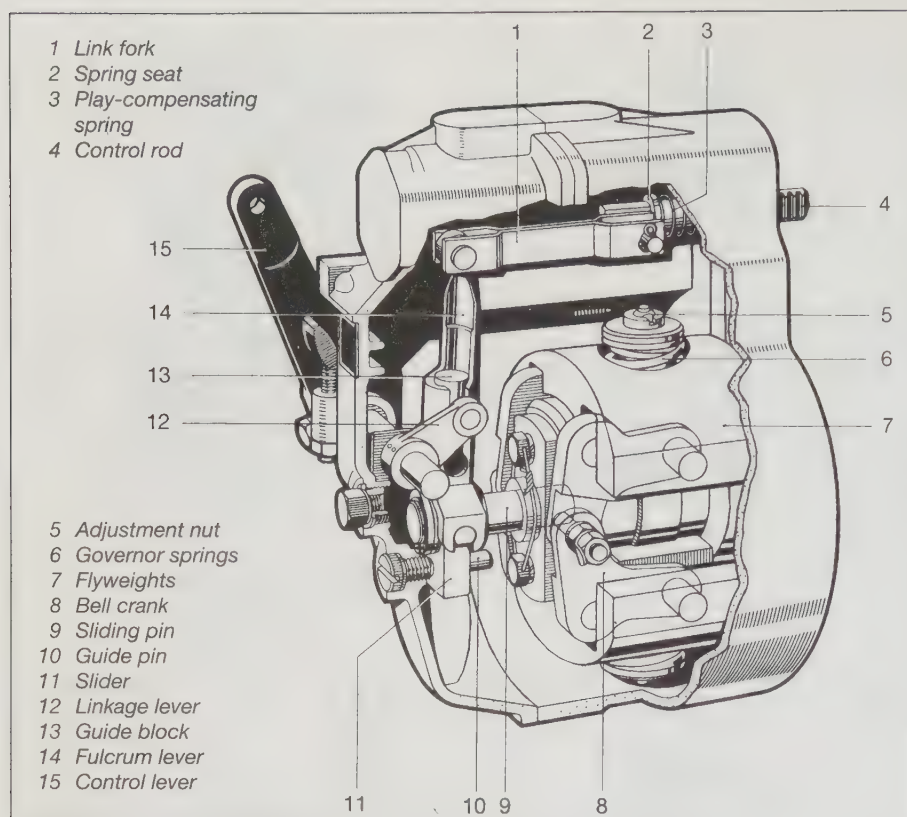
Maintenance

29 Governor lubrication is almost always integral with that of the injection pump. When a separate oil filler/level plug or dipstick is provided, the oil level should be checked every 1000 miles (1500 km) or 50 hours. The oil level may rise due to fuel dilution, and in this case the excess must be drained off when checking. Every 10 000 miles (15 000 km) or 500 hours, the oil should be renewed.

RQ centrifugal governor

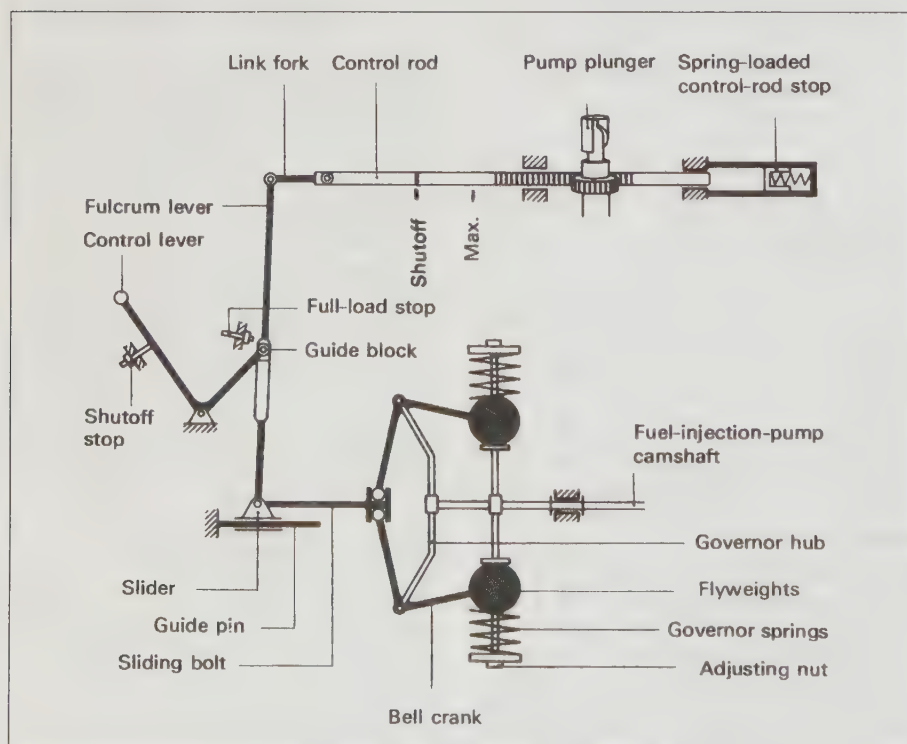
30 The RQ governor is a centrifugal idle/maximum speed governor. It is fitted to pump types A and P.

31 The governor is mounted on the end of the pump. The governor hub is driven, via a vibration damper, from the pump camshaft. The hub carries two flyweights, each weight with its own spring set. Bellcranks convert the radial movement of the weights into axial movement of a slider. Movement of the slider



5.31a Cutaway view of the RQ centrifugal governor

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5.31b RQ centrifugal governor schematic diagram

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is transmitted to the pump control rod via a fulcrum lever (**see illustrations**).

32 The engine speed control lever is also connected to the fulcrum lever, via a guide block which slides up and down inside a channel in the lever. This sliding linkage alters the effective pivot point of the fulcrum lever for the governor, and ensures that even at low speeds, the centrifugal force of the weights is sufficient to move the control rod (**see illustration**).

33 The spring set in each weight is made up of three springs arranged concentrically. The outer spring bears directly on the flyweight, while the inner springs bear on an inner seat. The outer ends of all the springs bear on an outer seat, the position of which is adjustable by a nut.

34 At low speeds, only the outer spring is effective, the force of the other two being taken on the inner seat. When the outer spring is compressed far enough by the weight, the weight bears on the inner seat. This marks the end of idle speed control.

35 Further increase in speed increases the force of the flyweight until it is great enough to compress all three springs. At this point, which marks the beginning of maximum-speed control, the inner seat moves with the weight (**see illustration**).

Start-up

36 The accelerator pedal is fully depressed, which moves the control lever to the full-load position. The pump control rod overcomes the resistance of the spring-loaded full-load stop, and moves into the position for starting fuel delivery (**see illustration**).

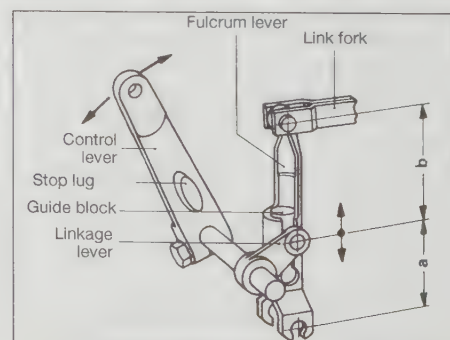
37 When the engine begins to operate, the driver releases the accelerator, and idle regulation begins.

Idling

38 The control lever rests against its idle stop. If engine speed reduces, the governor weights move inwards, and the control rod is moved in the direction of increased fuel delivery (**see illustration**). If engine speed rises, the reverse occurs.

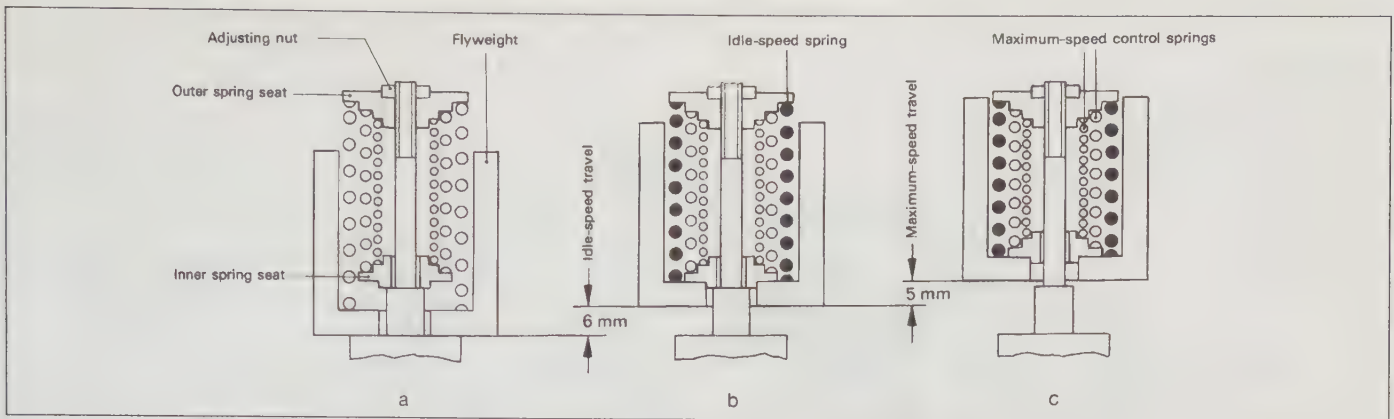
On the road

39 As soon as the accelerator pedal is depressed and the engine speed rises above idle, the governor weights compress the idle speed control springs fully and rest on the



5.32 Variable fulcrum point in RQ governor

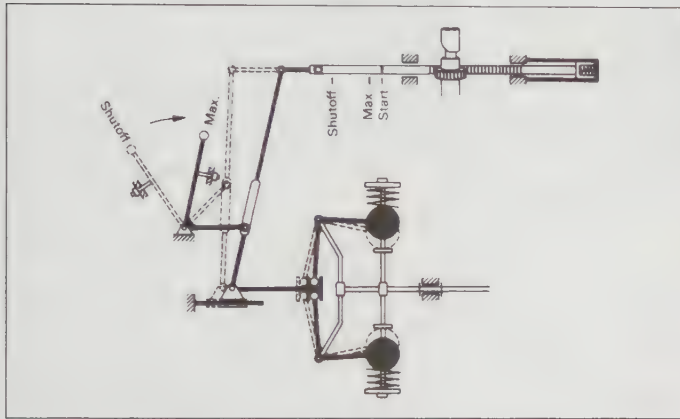
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5.35 RQ governor flyweights and springs at various speeds

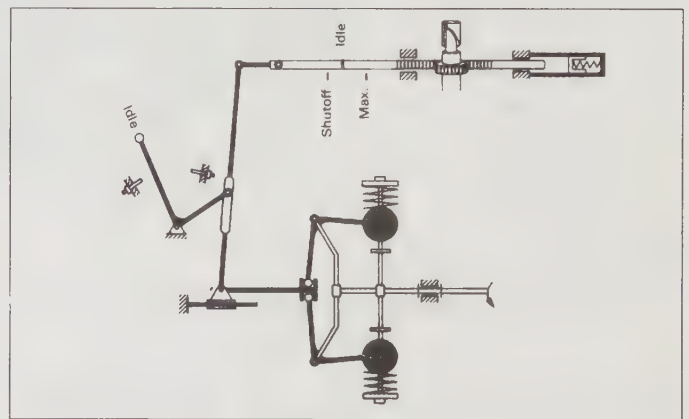
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a Stationary b Idling c Maximum speed



5.36 RQ governor in "start" position

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5.38 RQ governor in "idle" position

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inner spring seats. The position of the weights does not alter until maximum speed is approached. At intermediate speeds, fuel delivery is determined by the position of the accelerator.

Maximum speed

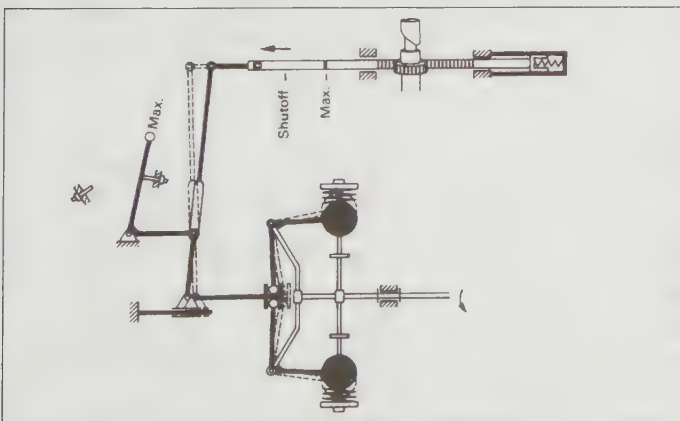
40 When the flyweights begin to compress

the maximum-speed control springs, the fulcrum lever moves the control rod to reduce fuel delivery (see illustration). The position of the control rod is thus dependent both on the governor and on the position of the accelerator. If engine speed continues to rise, the effect of the governor exceeds that of the

accelerator, to the point where fuel delivery may be cut off altogether.

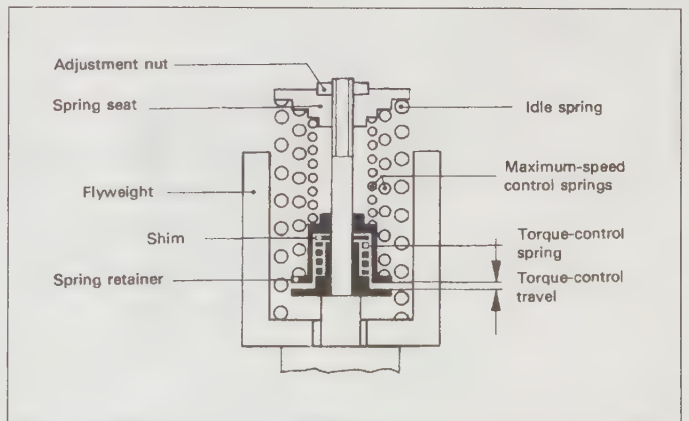
Torque control

41 Positive torque control is achieved by introducing an extra spring in series with the maximum-speed control springs (see illustration). The travel which this spring



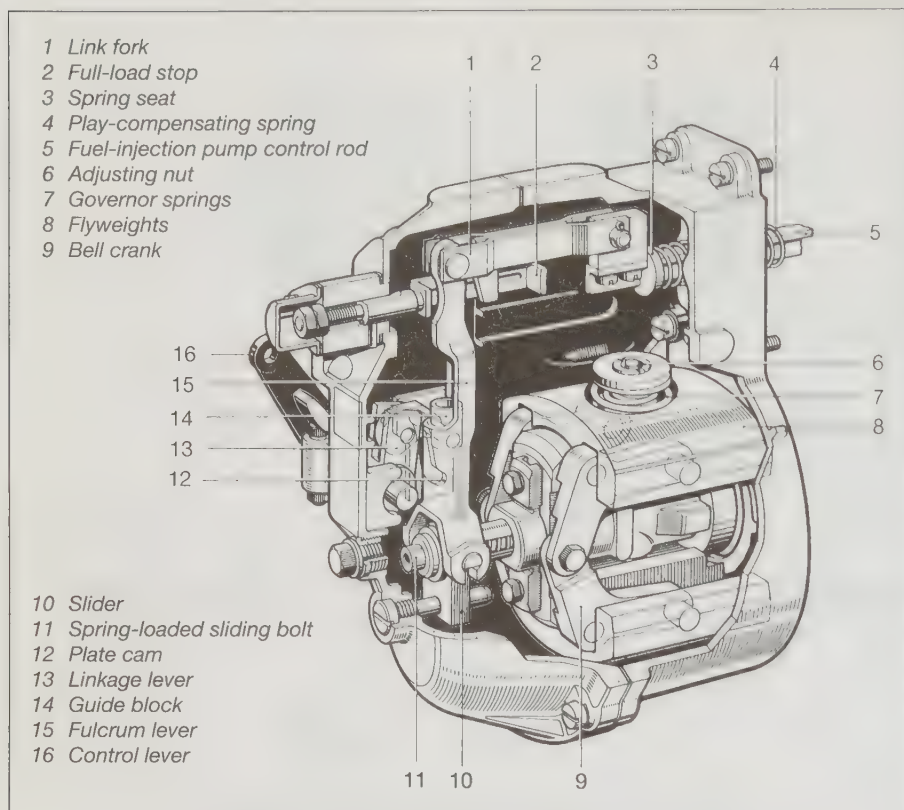
5.40 RQ governor in maximum-speed/maximum-load position

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5.41 Torque control springs in the RQ governor

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5.42 Cutaway view of Bosch RQV governor

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allows can be varied with shims. The weights begin to compress the torque control springs at some speed in between idle and maximum speed. Fuel delivery is then reduced with increasing speed, until the torque control travel is taken up.

RQV centrifugal governor

42 The RQV governor closely resembles the type RQ just described, but it also incorporates a variable-speed control function (see illustrations). (A variant known as a

combination governor has control over a part of the intermediate speed range, but has an uncontrolled speed range as well.) It is fitted to pump types A and P.

43 The flyweight springs on this governor type are graded so that there is continuous movement of the weights over the entire speed range, instead of just around idle and maximum speed.

44 The connection between the governor and the fulcrum lever is spring-loaded by a spring known as a *drag spring* (see illustration).

Start-up

45 The control lever is moved to the full-load position (accelerator pedal fully depressed). The pump control rod moves past the automatic full-load stop, which is unlatched, and into the position for starting fuel delivery.

Idling

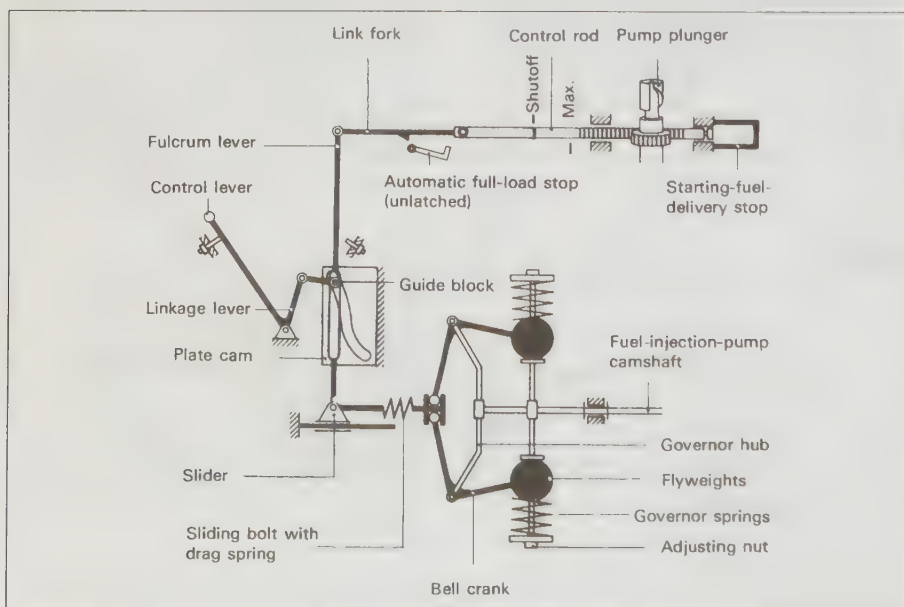
46 The governor functions in the same way as the RQ governor.

On the road

47 For each position of the accelerator pedal, there is an engine speed at which regulation begins. When the pedal is initially depressed, the variable ratio of the fulcrum lever causes the pump control lever to take up the 'maximum-delivery' position, even if full throttle has not been applied. Further depression of the accelerator will tension the drag spring.

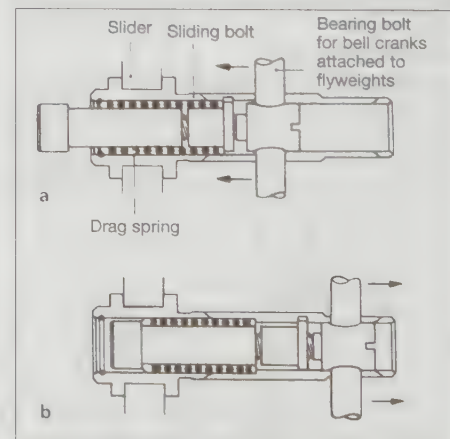
48 As the engine speed rises, the flyweights move outwards, but they have no effect on the control rod until the tension in the drag spring has been released. Further movement of the weights then results in decreased fuel delivery.

49 Increasing load will tend to reduce engine speed, and the flyweights will move inwards. At first, this movement will result in control rod movement to increase fuel delivery. When the control rod full-load stop is reached, further movement of the weights inwards will tension the drag spring (see illustration).



5.44 RQV governor schematic diagram

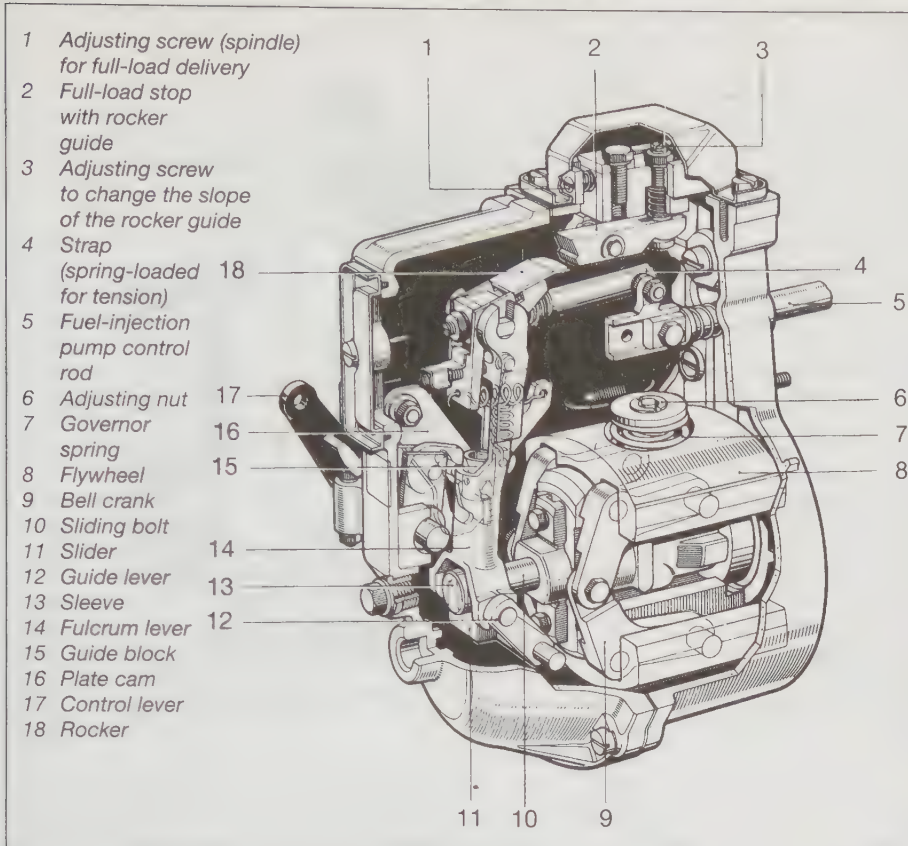
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5.49 Drag spring and sliding bolt - RQV governor

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- a Acceleration (control rod at full-load stop)
- b Maximum speed on overrun (control rod at shut-off stop)



5.52 Cutaway view of Bosch RQV-K governor

© Robert Bosch Limited

50 Reducing load and increasing speed will move the flyweights outwards, reducing fuel delivery. Once the control rod reaches the shut-off position, further movement of the weights will compress the drag spring.

Torque control

51 Positive torque control is applied using the drag spring and a spring-loaded control rod stop.

RQV-K centrifugal governor

52 The RQV-K governor has the same type of weight and spring assembly as the type RQV. It differs from the RQV (and from all other in-line pump governors) in the system used for torque control, and in the fact that negative as well as positive torque control can be applied (see illustration). It is fitted to pump types A and P.

53 The fulcrum lever is connected to the pump control rod by a spring-loaded strap. The fulcrum lever and strap meet at a rocker which runs along a curved track (rocker guide) at the full-load stop (see illustration).

54 The fulcrum lever guide block runs in a track on a plate cam. The cam is pivoted at one corner, and attached to a return spring.

Start-up

55 The control lever is moved to the maximum-speed position (accelerator pedal fully depressed). The rocker moves under the full-load stop, and the pump control rod is moved to the starting delivery position.

Idling

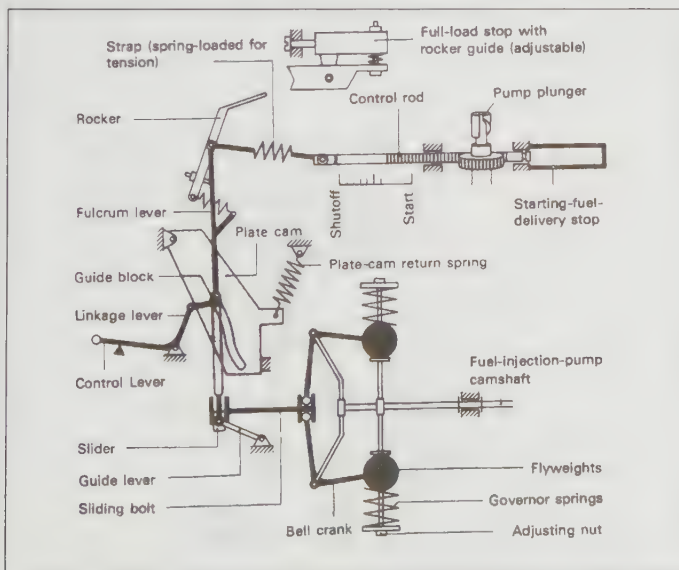
56 The governor functions in the same way as the RQ governor.

On the road

57 As with the RQV governor, for each position of the accelerator pedal, there is an engine speed at which regulation begins. Speed regulation is still carried out by the flyweights, but the full-load delivery is affected by the torque control systems.

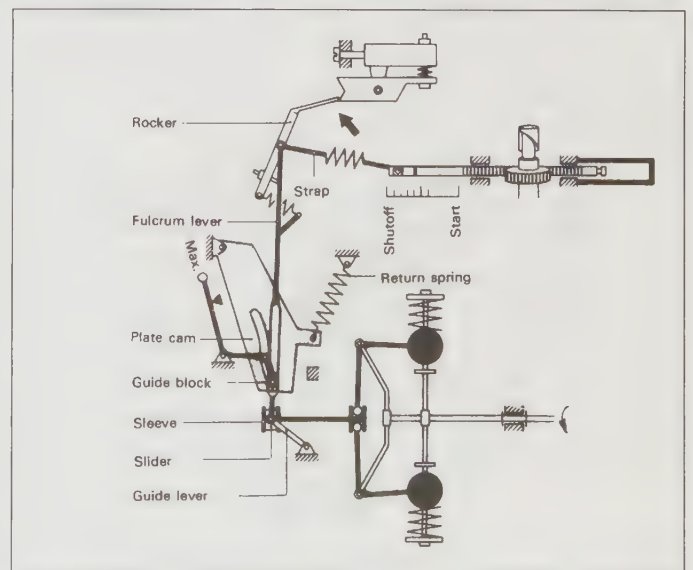
Torque control

58 If the accelerator pedal is fully depressed at low speed, the fulcrum lever guide block moves downwards in the plate cam track and in the fulcrum lever channel (see illustration). The plate cam is lifted off its stop against the



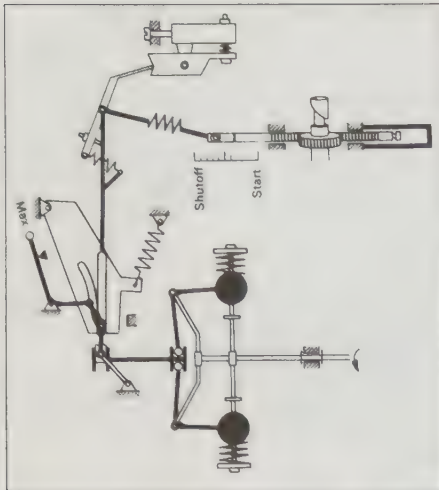
5.53 RQV-K governor schematic diagram

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5.58 RQV-K governor - full-load, low-speed position

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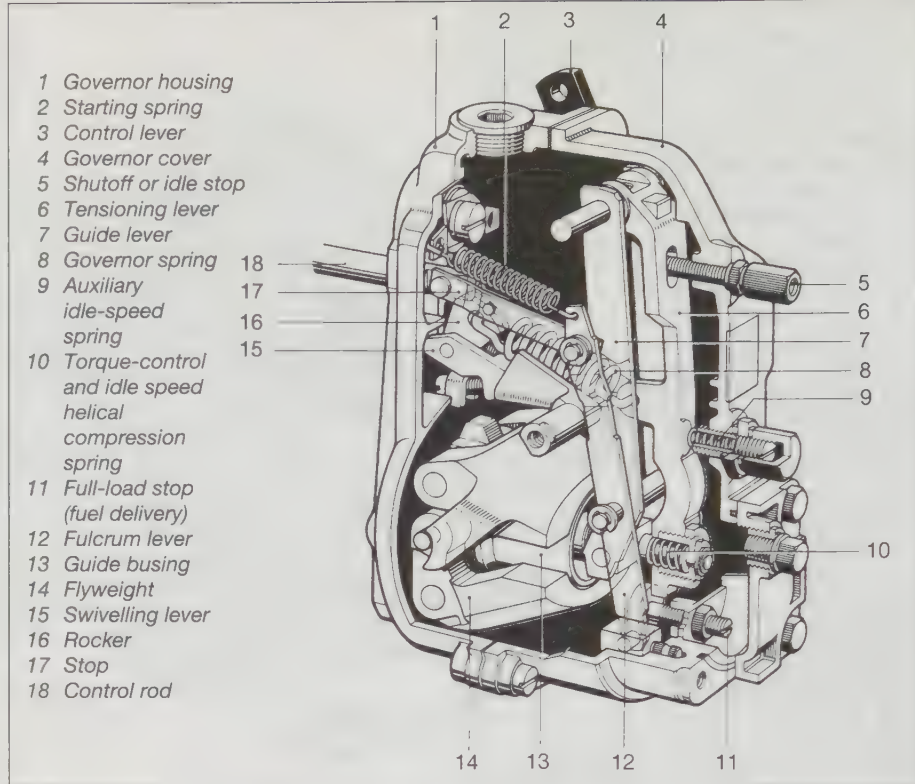
5.59 RQV-K governor - full-load, medium-speed position

© Robert Bosch Limited

effort of the return spring. The fulcrum lever moves the control rod into the maximum-delivery position. This position is determined by the profile of the rocker guide; at low speed, the rocker arm contacts the bottom of the guide.

59 As speed rises, flyweight movement is transmitted to the fulcrum lever. The guide lever and the fulcrum lever are both raised, so the rocker arm moves further up the guide. With the 'fishtail' shape guide shown in the illustrations, movement from the bottom of the guide towards the middle section increases fuel delivery (*negative torque control*) (see illustration).

60 Further increase in speed takes the rocker arm up onto the reverse slope of the fishtail. Maximum delivery is reduced with increasing speed (*positive torque control*).



5.61a Cutaway view of Bosch EP/RSV governor

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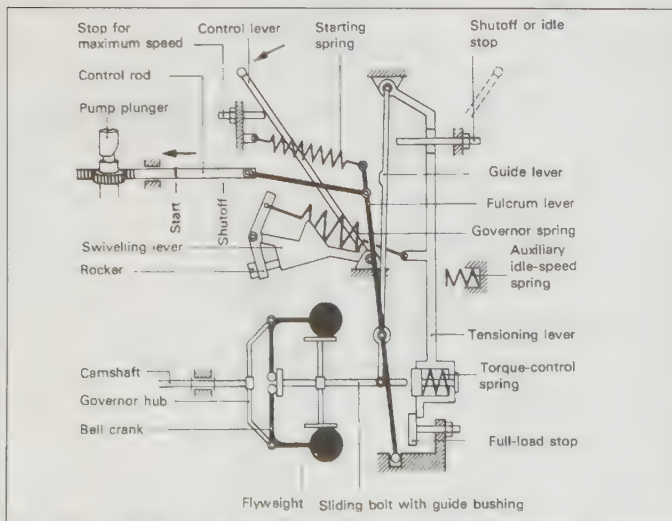
EP/RSV centrifugal governor

61 The EP/RSV governor is a variable-speed type. Unlike the RQ series governors, it has only one governor spring, which is separate from the flyweights. The governor spring is attached to a lever known as the *tensioning lever*. Additional springs are used for starting, idling, and torque control (see illustrations).

Start-up

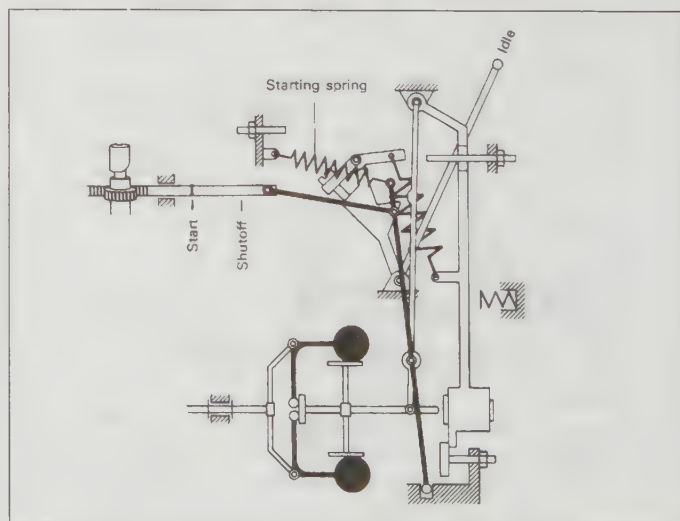
62 With the engine stopped, the starting spring acts unopposed on the fulcrum lever, which moves the pump control rod into the position for starting fuel delivery (see illustration). This happens without the accelerator pedal being depressed.

63 As soon as the engine turns, the flyweights begin to swing out. The sliding bolt



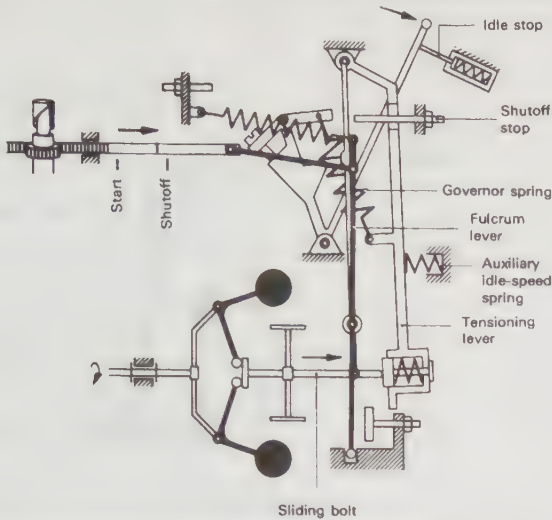
5.61b EP/RSV governor schematic diagram

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5.62 EP/RSV governor in starting position

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5.65 EP/RSV governor in idling position

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moves the guide lever (and through it, the fulcrum lever), overcoming the force of the starting spring, and the pump control rod is moved into the idling position.

Idling

64 With the speed control lever on the idle stop, the governor spring is almost slack. This lack of tension allows the flyweights to move outwards, even at low speed. Outward movement of the weights with increased speed moves the guide lever and fulcrum lever in the direction to reduce fuel delivery, and vice-versa.

65 In this phase of operation, the tensioning lever is resting on the auxiliary idle spring. The auxiliary spring acts against the force transmitted by the flyweights, and gives greater smoothness of control (see illustration).

On the road

66 When the accelerator pedal is depressed, the speed control lever moves off the idle stop. Movement of the swivelling lever by the control lever increases the tension of the governor spring. This increased spring force overcomes that of the flyweights. The tensioning lever is drawn against the full-load stop, and the control rod is moved to maximum delivery.

67 As engine speed rises, the force exerted by the flyweights comes back into balance with the governor spring force. The control rod is moved back towards reduced fuel delivery until the forces are in balance, and engine speed stabilises at this level.

68 If the accelerator is depressed as far as possible, the speed control lever moves up

against the maximum-speed stop. The swivelling lever applies the maximum tension to the governor spring. As long as the spring force exceeds the force of the flyweights, fuel delivery is at maximum.

69 As engine speed approaches the governed maximum, the force of the flyweights once more prevails. The tensioning lever is moved away from the spring, and the fulcrum lever moves the control rod towards the shut-off position.

Torque control

70 Positive torque control is achieved using a spring in the tensioning lever. With the tensioning lever resting on the full-load stop, rising speed will cause the torque control spring to be compressed before the tensioning lever moves. Compression of the spring allows the guide lever, the fulcrum lever and the control rod to move towards reducing fuel delivery (see illustrations).

Shut-off

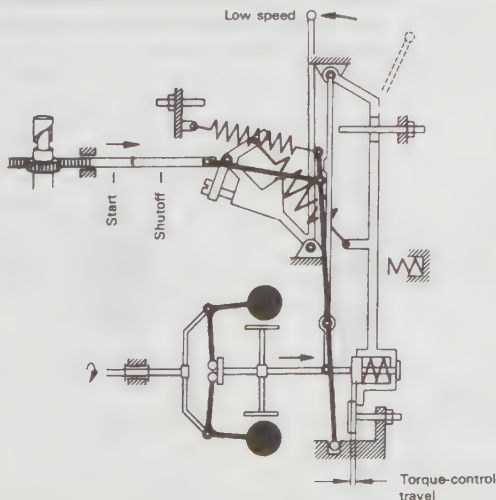
71 Shut-off may be carried out by moving the speed control lever to a shut-off position, when lugs on the swivelling lever press on the guide lever. The guide lever moves the fulcrum lever, which brings the pump control rod into the shut-off position.

72 Sometimes a separate stop lever is used. This achieves the same result by acting on the fulcrum lever.

EP/RS centrifugal governor

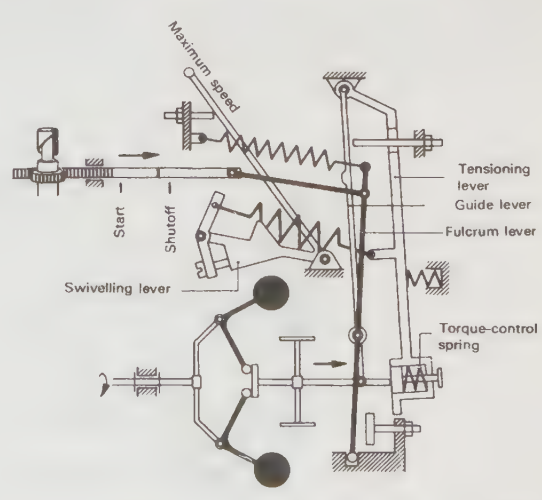
73 The EP/RS governor is an idle/maximum speed unit based on the EP/RSV governor described previously. The swivelling lever which alters governor spring tension in the EP/RSV governor is locked into the maximum-speed position. Speed control is carried out by a lever acting on the fulcrum lever. The idle and torque control springs are

2



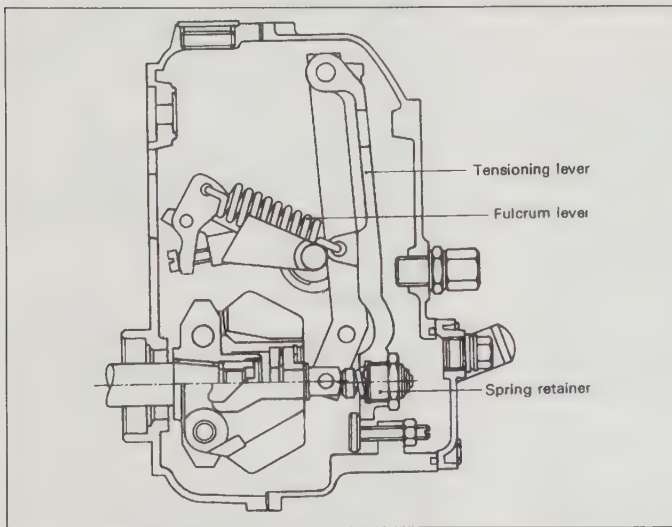
5.70a EP/RSV governor at full load and low speed; beginning of torque control

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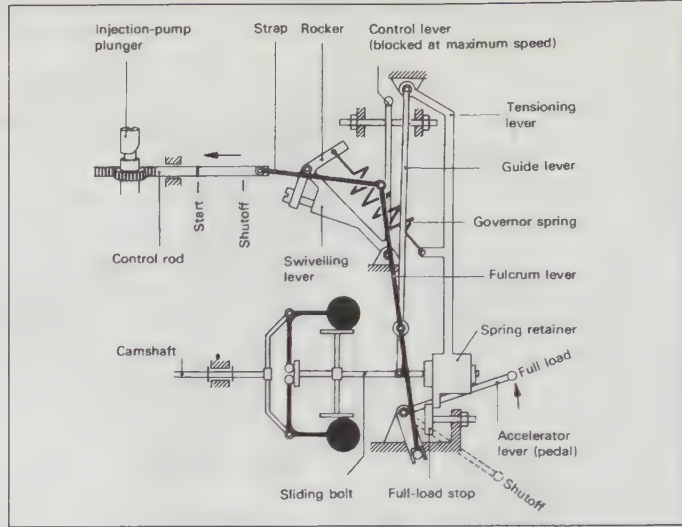
5.70b EP/RSV governor at full speed and low load

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5.73a Sectional view of Bosch EP/RS governor

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5.73b EP/RS governor schematic diagram

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housed in a retainer in the tensioning lever (see illustrations).

Start-up

74 The accelerator pedal must be fully depressed. Pressure of the idle spring on the sliding bolt moves the lever assembly and pump control rod to the starting fuel delivery position.

75 When the engine starts, the accelerator pedal is released. The flyweights move outwards, and the sliding bolt moves the lever assembly into the idling position.

Idling

76 The force exerted by the flyweights balances that of the idling spring. A reduction in speed reduces the flyweight force, and moves the lever assembly to increase fuel delivery, and vice-versa.

On the road

77 Speeds between idle and maximum are not controlled by the governor (except for

torque control, as described later). The position of the accelerator pedal determines fuel delivery.

78 At maximum speed, the flyweight force exceeds the governor spring force, and the sliding bolt moves the lever assembly to reduce fuel delivery.

Torque control

79 Torque control is achieved in the same way as on the EP/RSV governor.

Centrifugal governor control lever stops

80 Stops are provided to limit control lever travel in the positions for shut-off and maximum fuel delivery. Depending on governor type and application, these stops may be fixed, variable or spring-loaded, and additional stops may be provided.

Spring-loaded idle speed stop

81 The spring-loaded idle speed stop bears

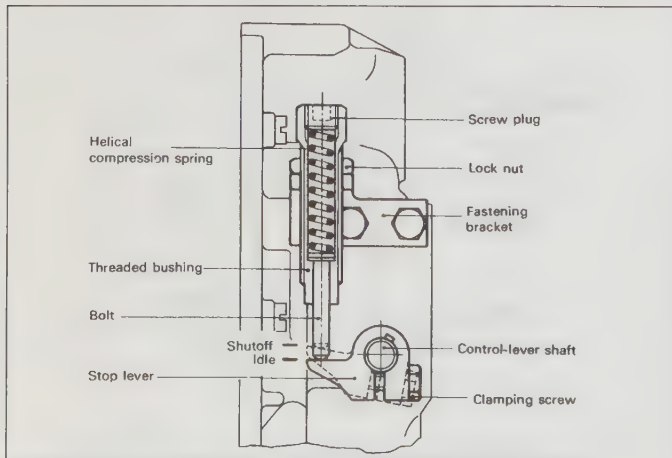
on a stop lever on the end of the control lever shaft. In normal use, the spring-loading keeps the shaft in the idle position (see illustration).

82 When it is wished to stop the engine, operation of the stop control overcomes the resistance of the idle speed stop spring. The control lever is moved into the stop position. When the engine has stopped and the control is released, the spring moves the lever back into the idle position.

Reduced-delivery stop

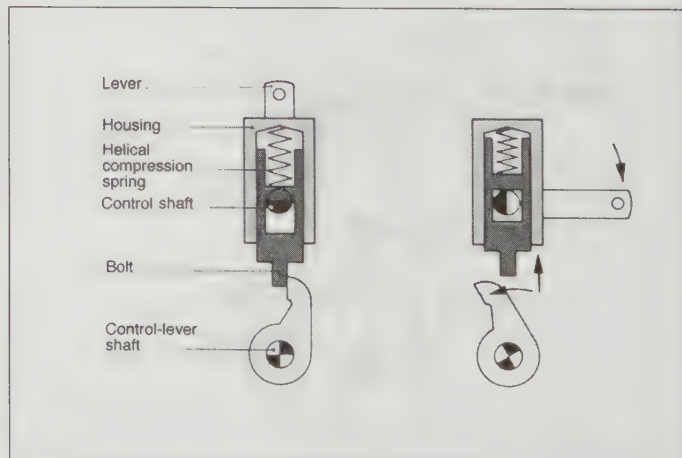
83 This stop limits control lever shaft travel towards maximum speed or maximum delivery. It may be used for setting a fixed intermediate speed.

84 The stop is spring-loaded, and is controlled by a shaft with a flat on it. When the shaft is turned, the flat raises the stop out of the way of a stop lever on the control lever shaft (see illustration). Maximum speed or delivery is then available.



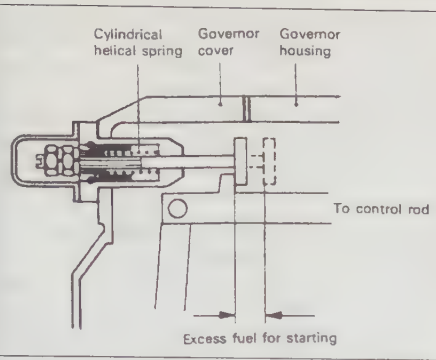
5.81 Spring-loaded idle speed stop

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5.84 Sectional views of reduced delivery stop

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5.88 Spring-loaded excess fuel stop

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Centrifugal governor control rod stops

85 Control rod stops are mainly concerned with releasing or blocking the excess fuel delivery required for start-up, and with torque control. They may also be used as part of a manifold pressure compensation system.

Rigid excess fuel stop

86 This type of stop is fitted to RQ governors. When the accelerator pedal is depressed for start-up, the stop limits the travel of the control rod to that required for starting fuel delivery. When the engine is running, the initial movement of the flyweights draws the control rod away from the stop.

87 The position of the stop is adjustable by means of a locknut and a threaded section.

Spring-loaded excess fuel stop

88 This is a development of the rigid stop. The accelerator pedal has to be depressed to overcome the spring-loading of the stop during initial start-up. As soon as the pedal is released, the spring moves the control rod back (see illustration).

Automatic full-load stop

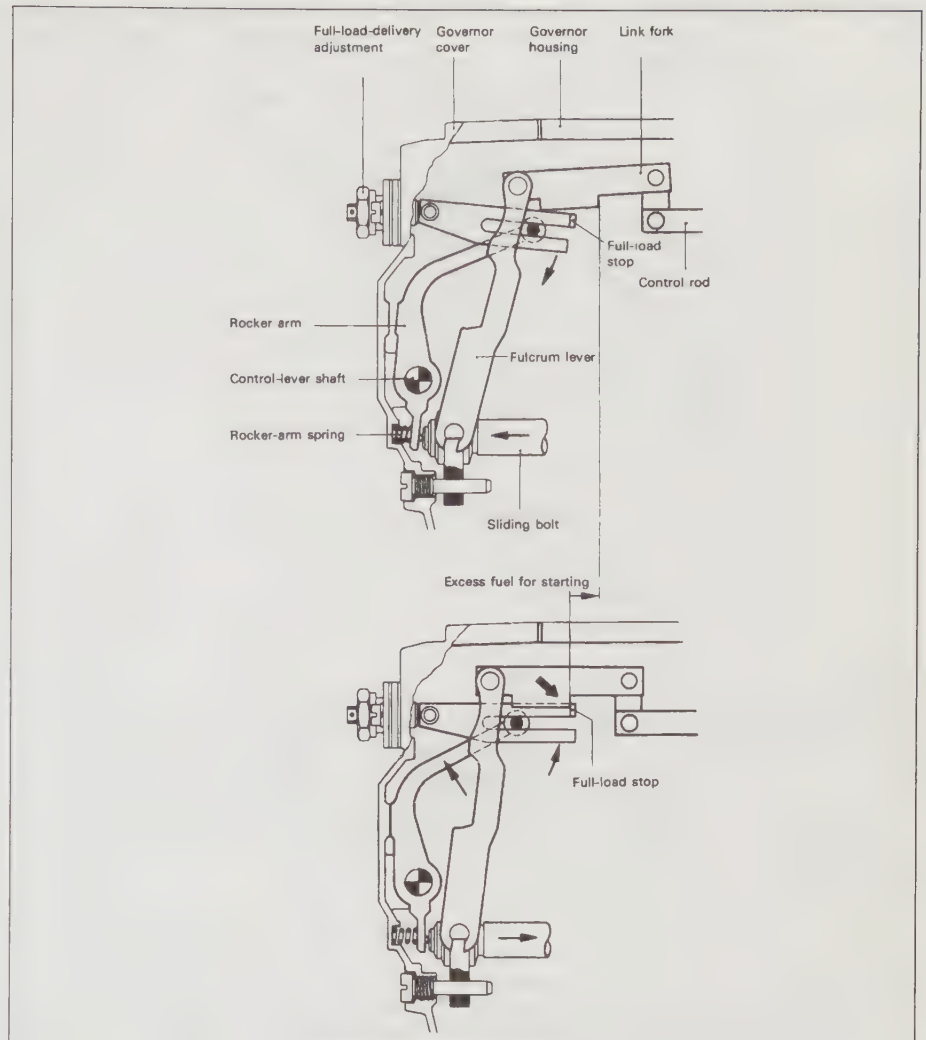
89 The components of this type of stop are a spring-loaded rocker arm and a full-load strap. When the engine is not running, pressure of the sliding bolt on the rocker arm moves the full-load strap downwards. This allows the control rod to move past the normal full-load position for start-up (see illustration).

90 With the engine running, the sliding bolt moves away from the rocker arm. The rocker arm lifts the full-load strap. The stop on the strap limits control rod movement to normal full-load.

Full-load stop with external torque control (RQV governor)

91 This stop has two functions. When an external draw lever is operated, a locking bolt allows movement of the stop to the start-up fuel delivery position. The other position of the draw lever puts the stop in the normal full-load position.

92 With the engine running, the balance of forces between the torque control spring and

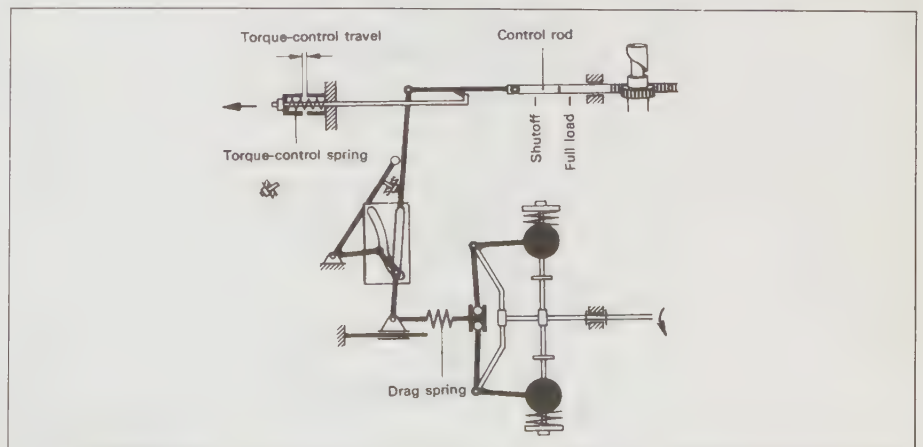


5.89 Automatic full-load stop

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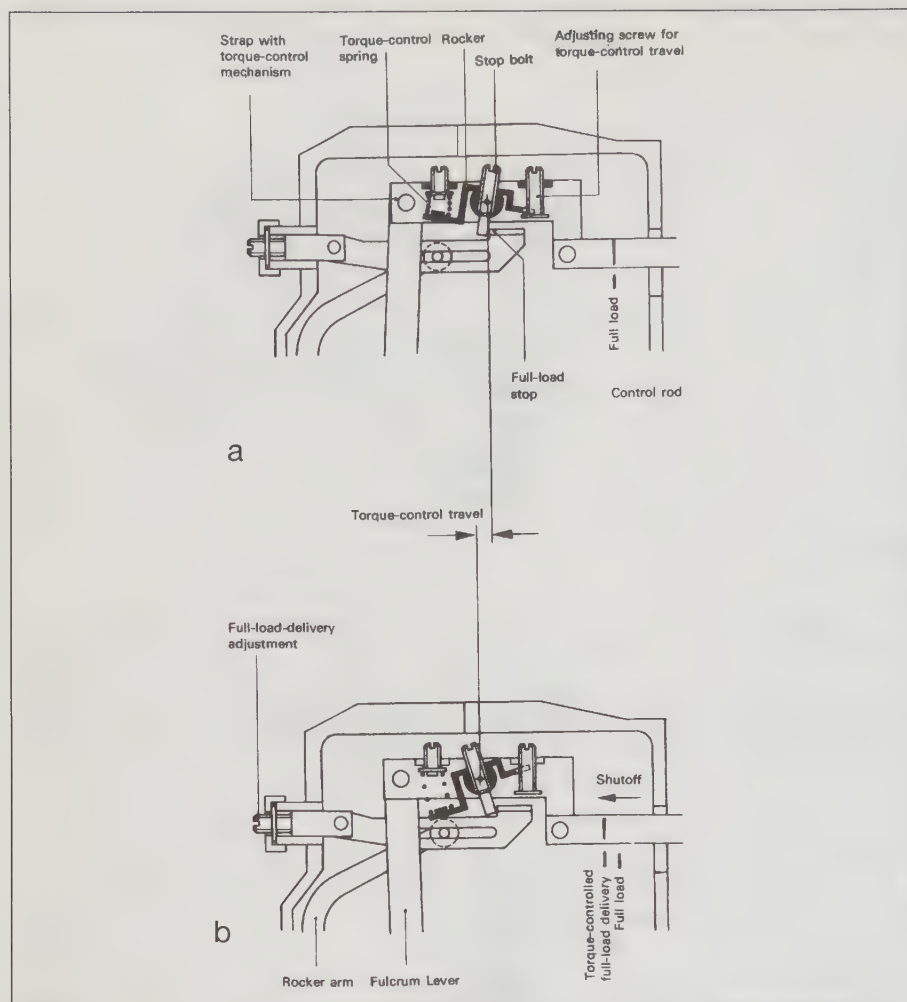
the governor drag spring provides a torque control function. When the torque control lever is moved to increase speed, the greater

tension on the drag spring moves the control rod into an increased-delivery position (see illustration). As speed increases, the drag



5.92 Full-load stop with external torque control

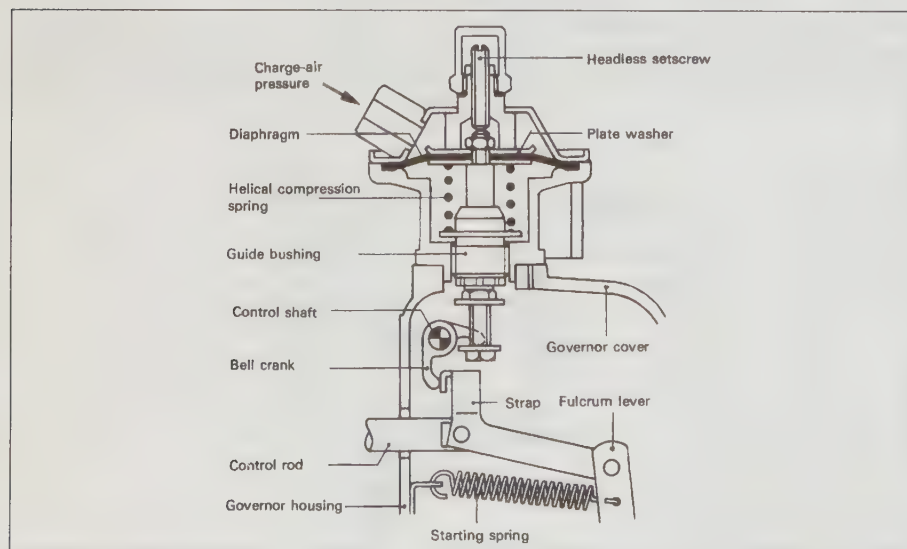
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5.94 RQV governor with internal torque control mechanism

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a Beginning of torque control b End of torque control



5.97 Sectional view of manifold pressure compensator

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spring relaxes, and the torque control spring moves the control rod to reduce fuel delivery. Thus fuel delivery is reduced with increasing speed (positive torque control).

93 The speed at which torque control begins can be adjusted by altering the tension of the torque control spring. The travel allowed for torque control can be varied using shims.

Full-load stop with internal torque control (RQV governor)

94 This type of stop uses a pivoting stop bolt attached to a rocker. One end of the rocker is under pressure from the torque control spring. At low engine speeds, the force of the drag spring is greater than that of the torque control spring, and the stop is in the normal full-load delivery position. As engine speed rises, the drag spring relaxes, allowing the torque control spring to move the rocker. The stop bolt pivots with the rocker, and sets a reduced full-load delivery position (see illustration).

95 The tension of the torque control spring can be adjusted by a screw which bears on the spring. Torque control travel is adjusted by another screw at the other end of the rocker.

Manifold pressure compensation (LDA)

96 Manifold pressure compensation is applied to turbocharged engines. It is explained fully in Section 6 – see *Bosch VE pump*.

97 The manifold pressure compensator is mounted on top of the pump. It contains a flexible diaphragm, which is subject to spring (and atmospheric) pressure on one side, and to inlet manifold pressure on the other. Movement of the diaphragm is transmitted by a threaded pin to a bellcrank. The other end of the bellcrank bears on the control rod strap (see illustration).

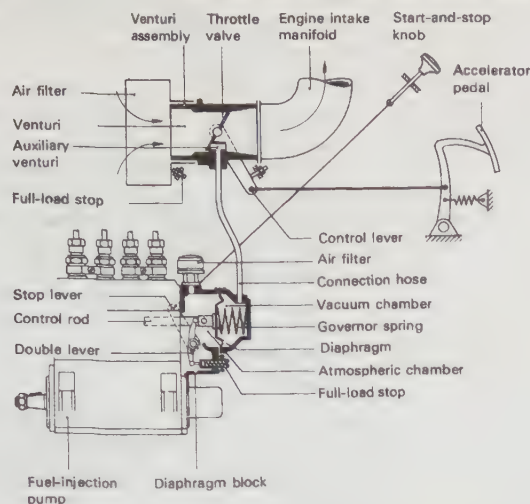
98 When manifold pressure is at its maximum (full turbo-boost), the bellcrank moves in the direction to permit maximum fuel delivery. At reduced pressures, the bellcrank limits control rod movement. Adjustments are possible to determine the travel of the bellcrank, and also the manifold pressure at the beginning and end of travel.

99 The bellcrank can be moved out of engagement with the control rod strap by means of a shaft. This is necessary when starting fuel delivery is required. The disengagement may be controlled mechanically (with a cable) or electrically (with a solenoid).

Altitude compensation (ADA)

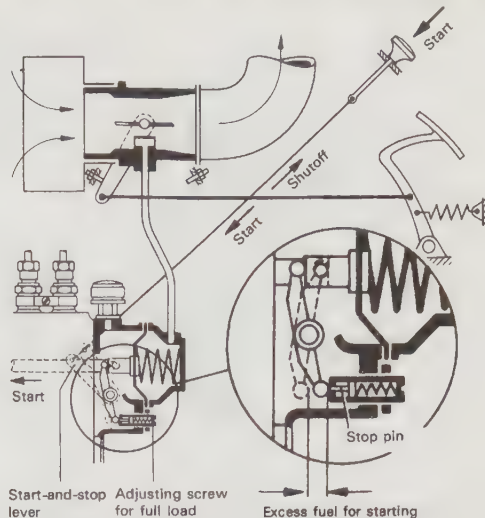
100 Altitude compensation involves reducing the full-load fuel delivery with increasing altitudes, to compensate for the reduced density of the air. It is not normally found on UK models, though it is used elsewhere in Europe.

101 Operation of the altitude compensator is similar to that of the manifold pressure



5.103 EP/M pneumatic governor schematic diagram

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5.105 EP/M governor in starting position

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compensator. The altitude compensator contains a vacuum (aneroid) capsule, which moves a sliding bolt. The lower end of the bolt is connected to a cam plate, which acts on the full-load stop strap.

102 As air density reduces, the aneroid capsule expands and the sliding bolt moves downwards. This movement is transmitted to the cam plate, which draws the full-load stop in the direction of reduced delivery.

EP/M pneumatic governor

103 The EP/M governor is a variable-speed type, and is found on pump types A and M. Unlike the other governors fitted to the PE pump, its operation is pneumatic, and depends on the provision of a throttle valve and a venturi in the inlet manifold. The main components of the governor are a diaphragm,

a vacuum chamber and a spring (see illustration).

104 The governor spring tends to force the pump control rod in the direction of increased fuel delivery. A full-load stop in the governor limits this travel. Vacuum produced in the venturi acts on the diaphragm in opposition to the spring, and pulls the control rod towards the shut-off position.

Start-up

105 An excess-fuel-delivery stop is released by the start-and-stop lever, which is connected to a start control. The governor spring moves the control rod into the starting fuel delivery position (see illustration).

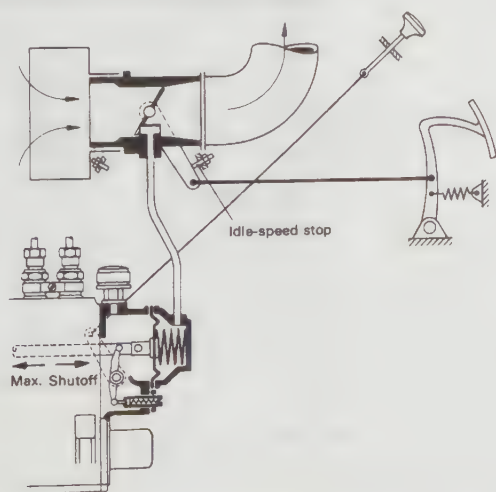
106 When the start control is released, spring-loading on the stop restores the normal full-load stop position.

Idling

107 The throttle valve is almost closed, and vacuum in the venturi is high. The vacuum acts on the governor diaphragm, and pulls the control rod towards the shut-off position (see illustration).

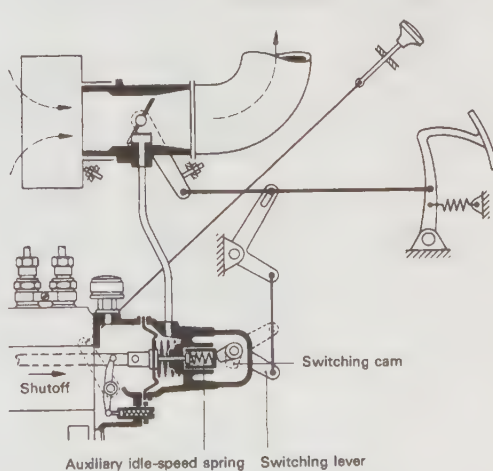
108 If engine speed falls, the vacuum in the venturi will also fall, and the diaphragm will move to increase fuel delivery. If the engine speed rises, the vacuum will increase, and fuel delivery will be reduced. In this way, the idle speed is stabilised.

109 On some designs of governor, an auxiliary idle speed spring is used (see illustration). This spring is stiffer than the main governor spring, and gives better regulation of idle speed. A switching cam may be used to unload the spring when the accelerator is moved out of the idle position.



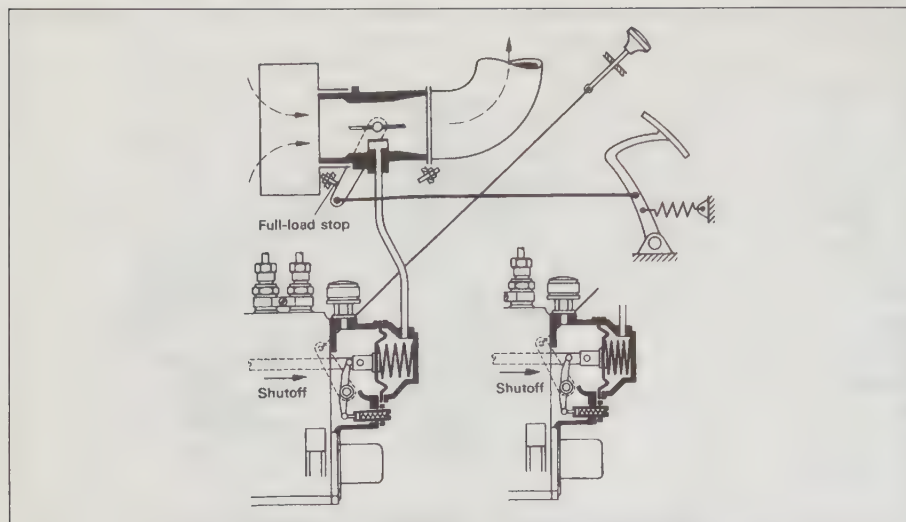
5.107 EP/M governor in idling position

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5.109 EP/M governor with auxiliary idle speed setting

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5.112 EP/M governor at full speed – left, at full load; right, unloaded

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110 A restrictor is sometimes fitted in the governor vacuum line, to damp out fluctuations in vacuum which occur at idle on engines with four or fewer cylinders. Another way of reducing the effect of fluctuations is to have some slack in the coupling between the diaphragm and the control rod, so that small pulsations of the diaphragm are not transmitted to the rod.

On the road

111 Depression of the accelerator pedal opens the throttle and reduces manifold vacuum. The governor spring moves the

control rod to increase fuel delivery. Engine speed will rise, and with it manifold vacuum, so that with increasing speed, the diaphragm moves the control rod back to reduce delivery.

112 For any given throttle position, there is an engine speed at which the vacuum and spring forces will be in balance. An increase in load will tend to decrease engine speed, reducing the vacuum and so increasing fuel delivery. A decrease in load has the reverse effect (see illustration).

113 The dimensions of the venturi are calculated so that at the maximum no-load

speed, even with the throttle wide open, the vacuum will be sufficient to move the control rod into the shut-off position.

Torque control

114 Positive torque control is achieved using a spring between the diaphragm and the control rod. When full throttle is applied at low rpm, vacuum is low or even negative, and the torque control spring is fully compressed by the governor spring. As the engine speeds up, the vacuum increases slightly, and the torque control spring can move the diaphragm and control rod to reduce fuel delivery (see illustration).

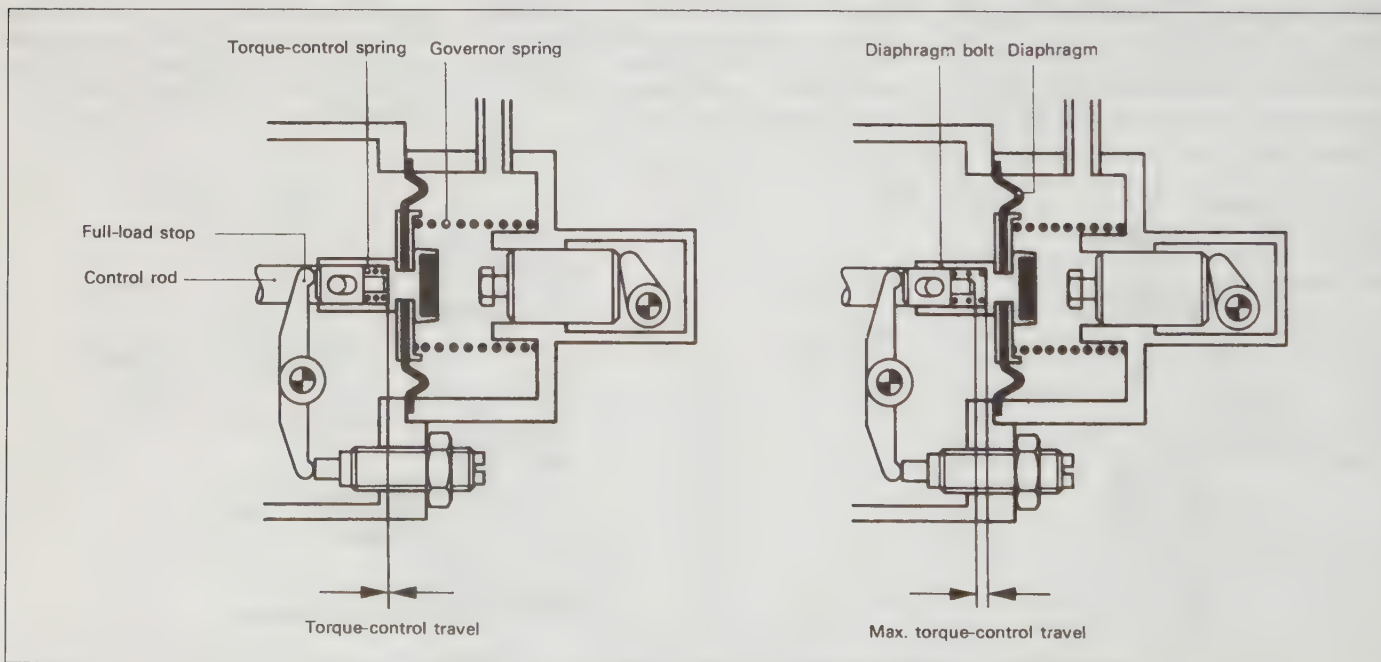
Shut-off

115 A stop control or actuator moves the start-and-stop lever into the shut-off position. The lever moves the control rod to stop fuel delivery.

Reverse-operation protection

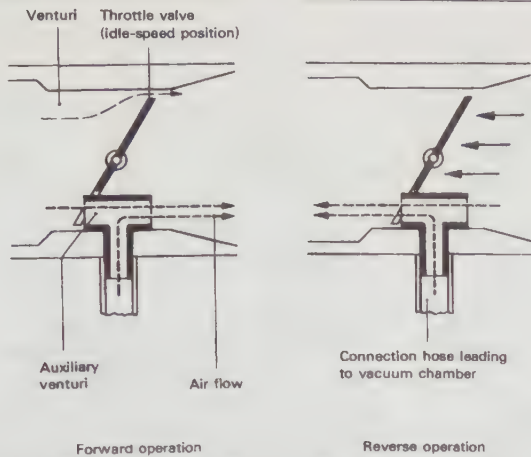
116 If an engine with a pneumatic governor starts to run backwards – for instance because of kicking-back during starting – there is a danger of it running away, since the exhaust gases will be entering the inlet manifold, and the governor diaphragm will be under pressure. The pressure on the diaphragm and the governor spring will act in the same direction, to increase fuel delivery, and the engine will run backwards out of control. In the worst case, damage will be caused to the engine bearings by inadequate lubrication, and the air cleaner will catch fire because of the exhaust gases passing through it.

117 To protect the engine against this runaway, an auxiliary venturi is provided



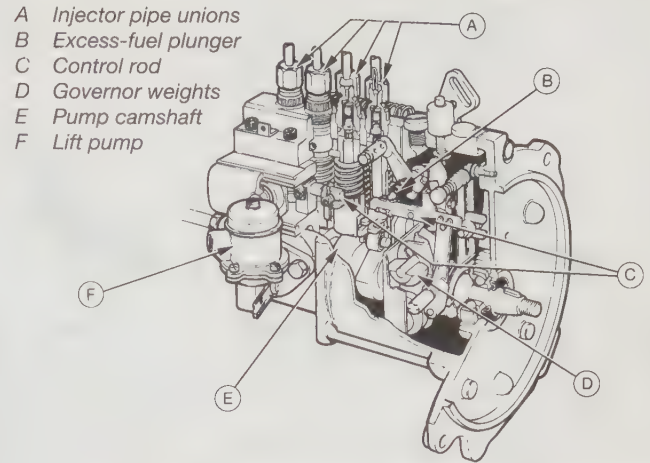
5.114 EP/M governor with torque control

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5.117 Venturi airflow during forward and reverse engine operation

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5.118 Cutaway view of a CAV Minimec pump

where the governor vacuum hose taps into the inlet manifold. In the event of reverse operation, the auxiliary venturi ensures that there is still a vacuum in the governor hose (see illustration). The engine can then be stopped by stalling it in gear, or by operating the stop control and fully depressing the accelerator.

CAV PUMP AND GOVERNOR

CAV Minimec pump

Basic principles

118 The CAV Minimec pump is similar in many respects to the Bosch PE pump previously described, being an in-line pump with an integral camshaft and a separate pumping element for each cylinder (see illustration). The version described here has a fuel lift pump, attached to the injection pump and driven by the injection pump camshaft. The low-pressure side of the pump is connected to the engine lubrication system; the high-pressure side is lubricated by the fuel passing through it.

Fuel lift pump

119 The fuel lift pump is of the diaphragm type, and has a hand-priming lever for use

when bleeding the fuel system (see illustration). The pump cover can be removed for attention to the diaphragm or valves.

High-pressure pumping elements

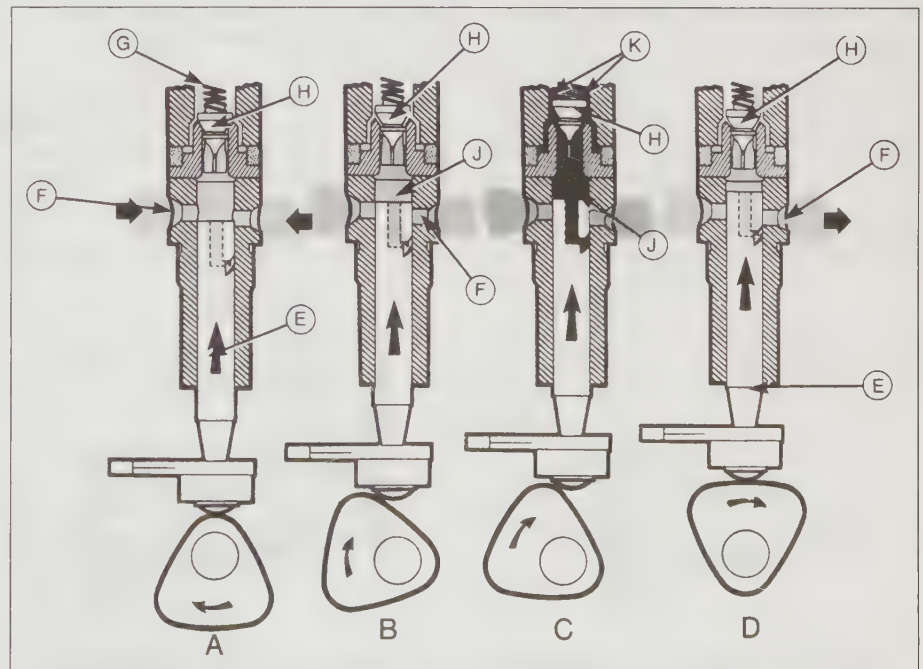
120 Each pumping element contains a plunger and barrel, which are matched to each other in production. At the top of each barrel is a delivery valve and a pressure control spring. Each barrel contains two inlet ports, through which fuel is supplied at lift pump pressure. The side of the plunger carries vertical and helical grooves; rotation of the plunger will

alter the point in the stroke at which the helical groove uncovers an inlet port.

The pump working cycle

121 With the pump plunger at BDC, fuel at lift pump pressure flows into the barrel through the inlet ports. The pressure control spring holds the delivery valve closed (see illustration).

122 The pump camshaft turns and lifts the plunger. The plunger closes the delivery ports, and the pressure of fuel in the barrel begins to increase.

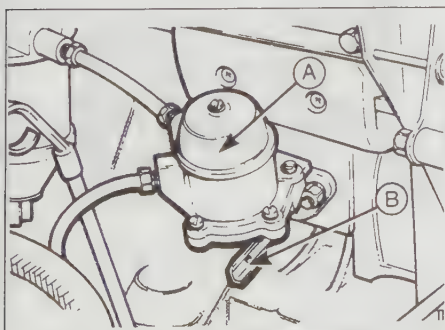


5.121 Minimec pump working cycle

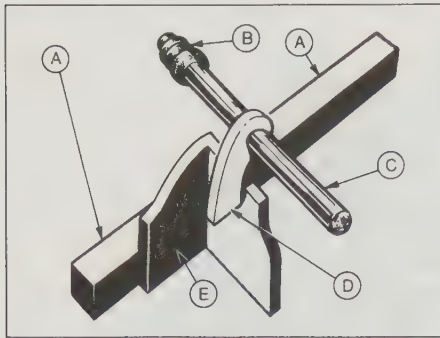
A Fuel inlet
B Fuel pressurisation
C Injection
D End of injection

E Plunger
F Inlet ports
G Pressure control spring

H Delivery valve
J Fuel charge under pressure
K Outlet ports

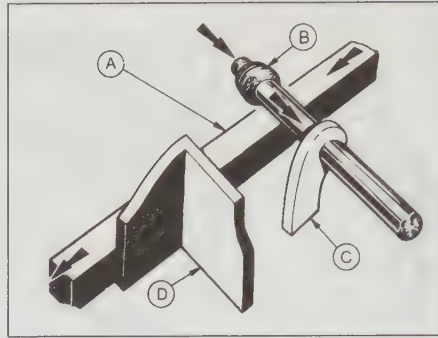


5.119 Fuel lift pump (A) and hand-priming lever (B)



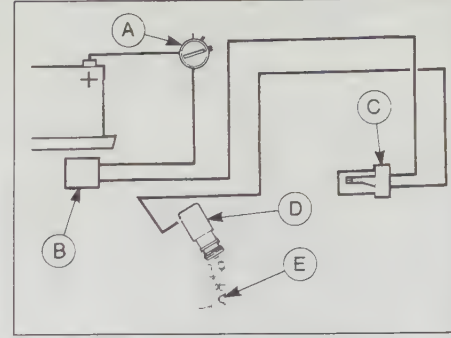
5.127a Excess-fuel device in normal (full-throttle) running position

- A Control rod
- B Excess-fuel button
- C Excess-fuel shaft
- D Excess-fuel stop
- E Control rod stop



5.127b Excess fuel device in cold-start position

- A Control rod
- B Excess-fuel button depressed
- C Excess-fuel stop
- D Control rod stop



5.127c Simplified wiring diagram of excess fuel solenoid

- A Ignition/starter switch
- B Starter motor relay
- C Temperature-sensitive switch
- D Excess-fuel solenoid
- E Excess-fuel button

123 Further movement of the plunger increases fuel pressure to the point where it overcomes the pressure control spring and opens the delivery valve. Fuel under pressure reaches the injector, and injection takes place. The amount of fuel injected depends on the duration of this stroke.

124 The end of the injection stroke occurs when the helical groove in the plunger uncovers one of the inlet ports in the barrel. Pressure in the barrel falls again to lift pump pressure, the delivery valve closes, and injection ceases. The plunger passes TDC, returns to BDC, and the cycle starts again.

Pump control

125 The amount of fuel injected is controlled by rotating the plungers in their barrels, so varying the point in the cycle at which the helical grooves uncover the inlet ports. The plungers are linked to a control rod for this purpose. Movement of the control rod is determined by the balance of forces between the throttle lever and the governor.

126 If the plungers are turned so that their vertical grooves are in line with the delivery ports, the ports will be exposed for the whole cycle, and no fuel delivery will take place. This position is selected when it is desired to stop the engine.

127 Excess fuel for start-up is provided by temporarily releasing a control rod stop. On the version shown here, the excess-fuel button, which releases the stop, is electrically-actuated by a solenoid. The solenoid is connected to the starter motor relay via a temperature-sensitive switch, so ensuring that extra fuel is only delivered during cranking at low temperatures (see illustrations).

Governor

128 An all-speed centrifugal governor is fitted. It consists of a pair of weights which revolve at pump camshaft speed. Movement of the weights is transmitted to a control sleeve, which in turn moves the pump control rod (see illustration).

129 Outward movement of the weights with

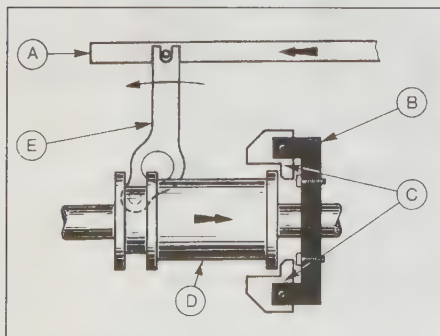
increasing speed moves the control rod towards the reduced-delivery position. This movement is opposed by a leaf spring which bears on the control sleeve; leaf spring tension is determined by throttle lever position.

130 At speeds below maximum, there is a balance between the force exerted by the governor weights in one direction and the leaf spring in the other. Increasing speed will tend to reduce fuel delivery, and vice-versa, so keeping engine speed constant within certain limits of load change (see illustration).

131 At maximum governed speed, the force of the weights will overcome the force of the leaf spring, and the control rod will be moved to shut off fuel delivery, regardless of throttle lever position (see illustration).

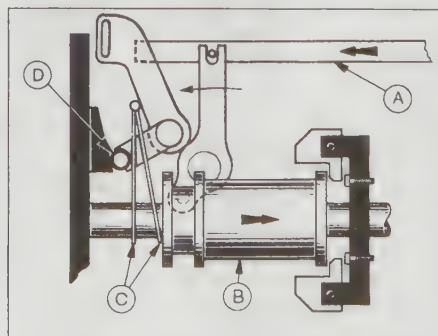
Timing mechanism

132 A centrifugal advance device is incorporated in the pump drive, in order to advance injection timing with increasing speed.



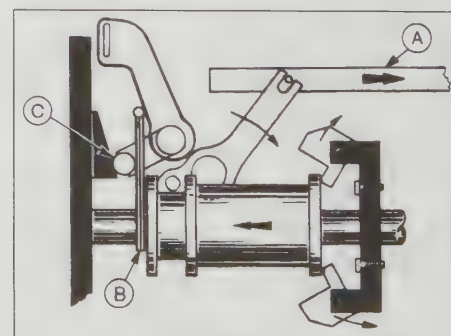
5.128 Side view of Minimec governor at low rpm

- A Control rod
- B Weight carrier
- C Weights
- D Control sleeve
- E Operating link



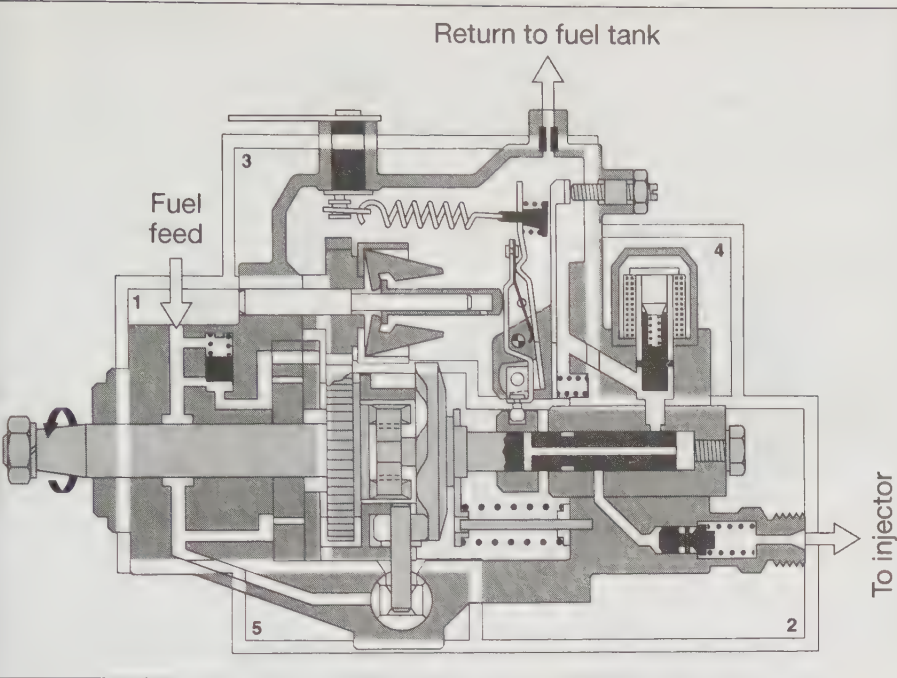
5.130 Relationship of Minimec throttle lever and governor (full throttle, low rpm)

- A Control rod
- B Control sleeve
- C Leaf spring
- D Throttle lever roller



5.131 Minimec governor in full-throttle/full-speed position

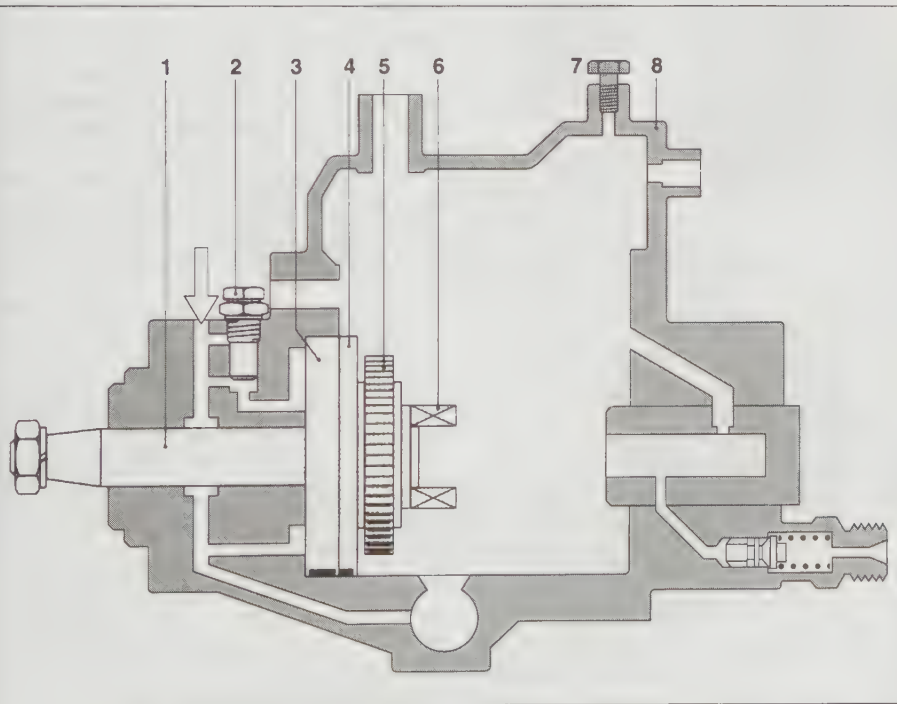
- A Control rod
- B Leaf spring (closed)
- C Throttle lever roller



6.3 Sectional view of Bosch VE distributor injection pump

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- | | |
|--------------------------------------|----------------------------|
| 1 Supply pump | 4 Shut-off solenoid |
| 2 High-pressure pump and distributor | 5 Injection timing control |
| 3 Governor | |



6.5 Supply pump and associated components – Bosch VE pump

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- | | | |
|--------------------------|----------------------|-----------------------|
| 1 Input shaft | 4 Support ring | 7 Overflow restrictor |
| 2 Pressure control valve | 5 Governor drivegear | 8 Housing |
| 3 Eccentric ring | 6 Drive dogs | |

6 Distributor injection pumps and governors

1 The function of a fuel injection pump is to supply fuel to the injectors at the correct pressure, at the correct moment in the combustion cycle, and for the length of time necessary to ensure efficient combustion.

2 Pump characteristics are carefully matched to a particular engine. This matching extends to the delivery valves, injector pipes and the injectors themselves. Substitution of any of these items with those from another engine or pump will not necessarily be successful, even if the substitute items have the same external dimensions.

BOSCH PUMP AND GOVERNORS

Bosch VE pump

3 The Bosch VE pump is a modern distributor pump, with an integral supply pump, timing mechanism and governor (see illustration). It is widely used on small and medium-sized engines. It is made in Germany, and under licence in countries such as Japan.

Basic principles

4 The pump draws in fuel by means of its supply pump. A high-pressure pump element produces the pressure necessary for injection. Fuel under pressure is directed to each delivery port in turn by the pump plunger rotating in the distributor head.

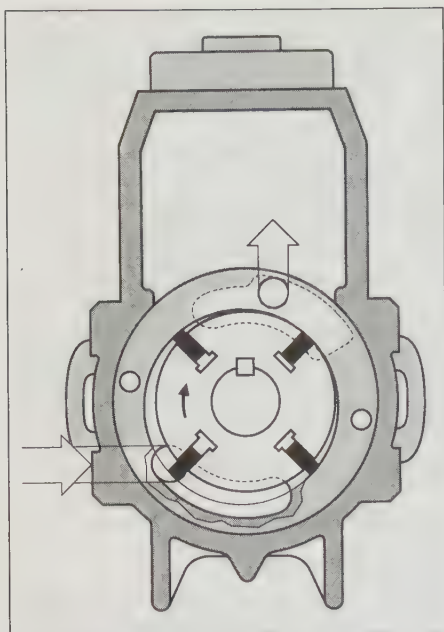
5 Pump drive is most commonly by toothed belt, though gear or chain drive is also found. The pump driveshaft operates the supply pump directly, and a gearwheel on the shaft drives the governor. Dogs on the end of the shaft drive a cam plate (sometimes called a swash plate), which rides on a roller ring. The cam plate both rotates, thanks to the shaft, and moves back and forth, thanks to the rollers. This combined rotary/back-and-forth movement is transmitted to the pump plunger (see illustration).

6 Lubrication of the pump is carried out entirely by the fuel.

Supply pump and low-pressure control

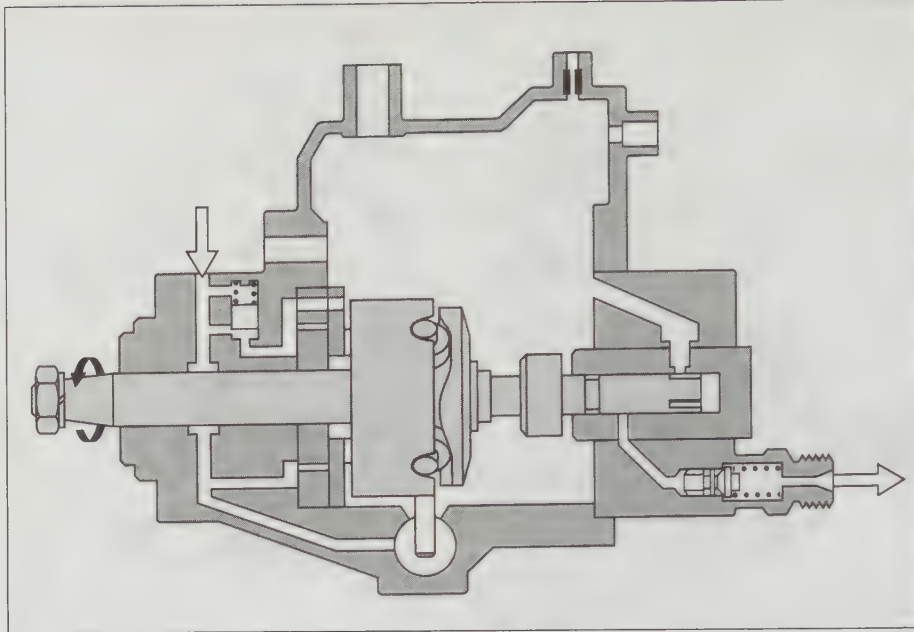
7 The supply pump impeller is keyed to the driveshaft, and runs inside an eccentric housing fixed to the body of the pump. Vanes in the impeller draw fuel in through the inlet port, and force it into the pump cavity (see illustration overleaf).

8 Part of the supply pump's output passes to a pressure control valve, which opens a bypass and returns excess fuel to the suction (inlet) side when the pressure exceeds a certain level. A further part leaves the pump cavity via an overflow restrictor, and is returned to the fuel tank. The overflow restrictor is at the highest point of the pump, so any air bubbles will be bled off in the returned fuel.



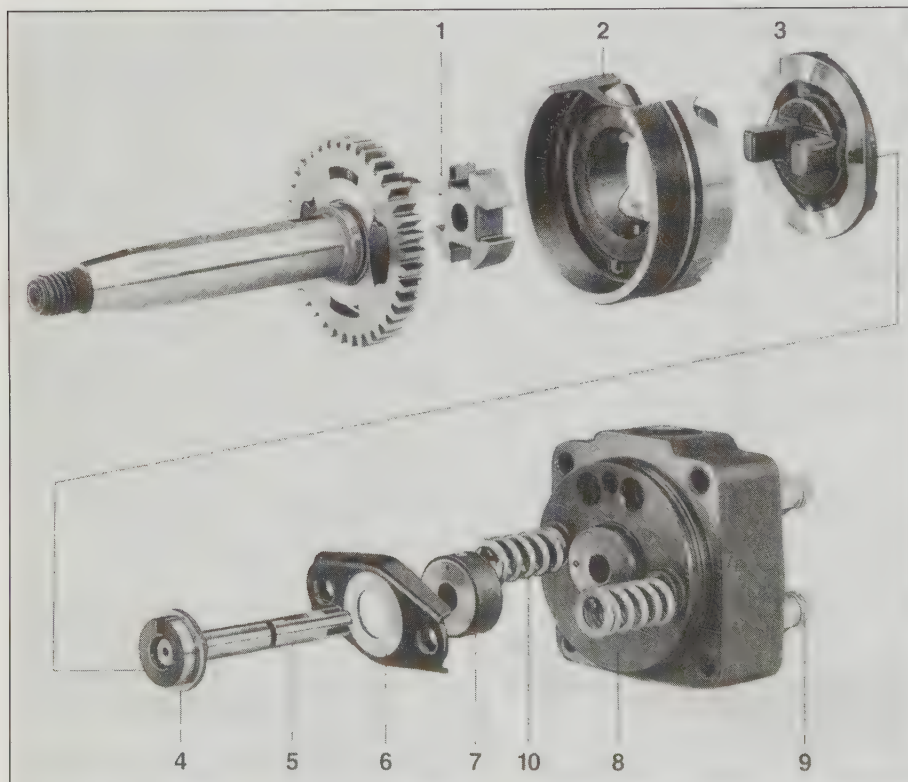
6.7 Supply pump operation – Bosch VE pump

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6.10a Location of high-pressure pump inside the VE pump cavity

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6.10b High-pressure pump components

© Robert Bosch Limited

- | | | |
|---------------|-----------------|--------------------|
| 1 Yoke | 5 Pump plunger | 8 Distributor head |
| 2 Roller ring | 6 Spring link | 9 Delivery tube |
| 3 Cam plate | 7 Control spool | 10 Return spring |
| 4 Flange | | |

9 The pressure control valve and the overflow restrictor between them determine pump cavity pressure, which varies in proportion to speed, and is used to control injection timing.

High-pressure pump

10 The high-pressure pump consists of a plunger working in a bore in the distributor head (see illustrations). As previously explained, the plunger rotates and moves back-and-forth. The back-and-forth movement provides the pumping effect. At the same time, the rotation brings a distributor slit in the plunger in line with each outlet bore in turn.

11 The plunger is forced towards TDC by the cam plate riding up on the rollers. It is returned to BDC by two springs which are sandwiched between the distributor head and a spring link. The spring link bears on a flange at the cam plate end of the plunger.

12 The profile of the cam plate determines injection pressure and duration. It is designed specifically for the combustion characteristics of the engine in question.

13 Where the pump plunger enters the distributor head, it passes through a cylindrical sleeve known as the control spool. The control spool can be moved back-and-forth by the governor. The point at which the control spool uncovers a cut-off bore in the pump plunger determines the end of injection.

14 The pump plunger, distributor head and control spool are precisely matched in production, and may only be renewed as an assembly.

The pump working cycle

15 The phases of the pump working cycle are shown in the accompanying illustration (see illustration).

16 The cycle starts with fuel entry. The pump plunger is at BDC, and fuel at pump cavity pressure flows through the inlet passages, along one of the metering slits in the end of the plunger, and into the high-pressure chamber.

17 As the plunger rotates and moves towards TDC, it closes the inlet passage, and pressurises the fuel in the high-pressure chamber. Further rotation brings the distributor slit in the plunger in line with one of the outlet bores in the distributor head. Fuel under pressure opens the delivery valve at the end of the outlet bore, and fuel delivery begins.

18 Continued movement of the plunger

towards TDC moves the plunger cut-off bore out of the control spool, causing the end of delivery. Fuel flows out of the high-pressure chamber via the cut-off bore, the pressure drops, and the delivery valve closes. The period between the beginning and end of fuel delivery is known as the *working stroke*.

19 The plunger completes its travel towards TDC, and fuel continues to flow from the cut-off bore. This is known as the *residual stroke*.

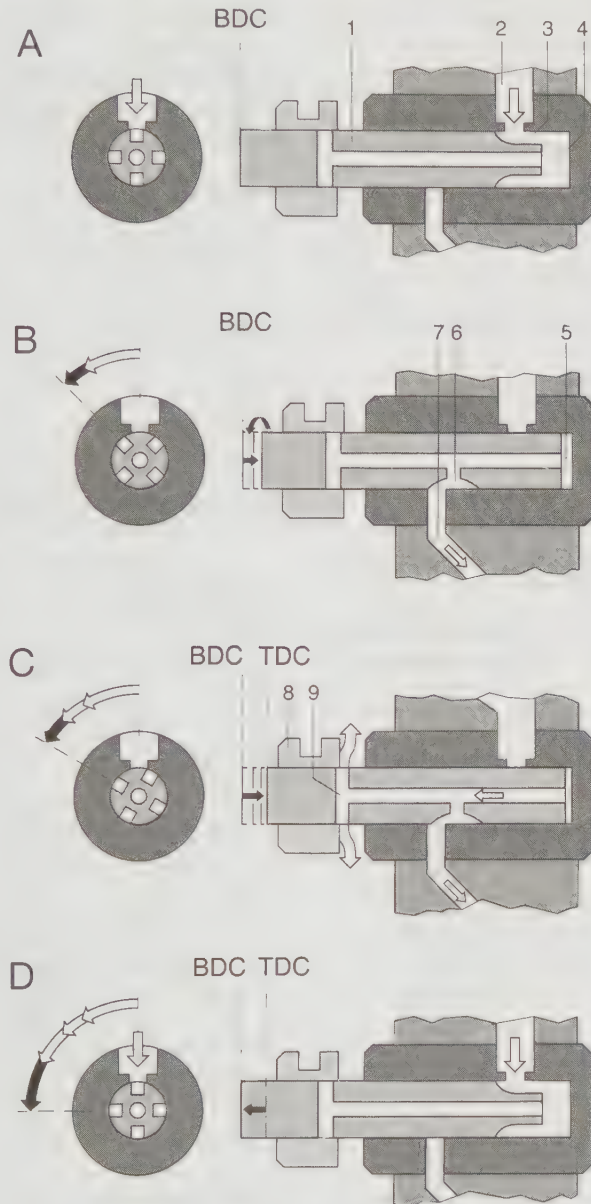
20 The plunger continues to rotate, and begins to return towards BDC. As the cut-off bore re-enters the control sleeve, the next metering slit comes into line with the inlet passage, and fuel entry begins again.

21 For each complete cycle, the plunger rotates one-quarter of a turn for a four-cylinder engine, one-sixth of a turn for a six-cylinder engine, and so on.

Delivery valves

22 The delivery valve separates the outlet bore from the injector pipe. The valve only opens when the pressure in the bore exceeds a certain value, and closes as soon as pressure begins to drop. This contributes to precise beginning and ending of injection.

23 In its simplest form, the delivery valve consists of a spring-loaded plunger in a holder (see illustration). The size and shape of the plunger are matched to the length and diameter of the injector pipe. When the valve closes, the retraction of the plunger increases the effective volume of the fuel pipe by a

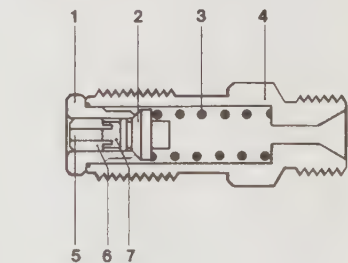


6.15 Bosch VE pump working cycle

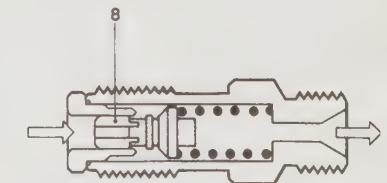
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- | | | |
|-----------------------------------|-------------------------|-------------------|
| 1 Pump plunger | 5 High-pressure chamber | 9 Cut-off bore |
| 2 Inlet passage | 6 Distributor slit | A Fuel entry |
| 3 Metering slit | 7 Outlet bore | B Working stroke |
| 4 High-pressure chamber (filling) | 8 Control spool | C Residual stroke |
| | | D Fuel entry |

a) closed.



b) open.



6.23 Delivery valve details – Bosch VE pump

© Robert Bosch Limited

- | | |
|-----------------|-----------------------|
| 1 Valve holder | 6 Relief piston |
| 2 Plunger head | 7 Ring groove |
| 3 Spring | 8 Longitudinal groove |
| 4 Body | |
| 5 Plunger shaft | |

2•24 Fuel injection systems

calculated amount. This relieves the pressure in the pipe, and makes the injector shut cleanly.

24 The delivery valve can also be part of a torque control system. (For an explanation of torque control, see Section 4.) This is done by profiling the plunger so that it offers a greater resistance to fuel flow at higher velocities.

25 A further refinement, known as *return-flow restriction*, allows the delivery valve to play an important part in reducing turbulence and cavitation in the injector pipe. The return-flow

restrictor valve sits on top of the delivery valve. It offers little resistance to fuel flow in the forward direction, but damps out the reverse-pulse which occurs when the injector needle snaps shut.

Timing advance device

26 Injection timing advances in response to increased pump cavity pressure, which is itself increased with speed.

27 The timing advance device consists of a piston in the bottom of the pump, at right-angles to the pump driveshaft, and below the roller ring (see illustration). The piston is subject to spring pressure on one side, and to pump cavity fuel pressure on the other. A sliding block and pin connect the piston with the roller ring. Movement of the piston rotates the roller ring.

28 Once the engine is running, spring pressure and pump cavity fuel pressure determine the position of the piston. Rising engine speed raises the pressure; the piston moves, and turns the roller ring so as to advance the timing. With falling engine speed, the reverse happens.

Additional features

29 So far, all the items described have been basic to the operation of the pump. The items in the following paragraphs will not be found on all pumps.

Positive torque control

30 Positive torque control can be achieved in two ways: by the delivery valves, or by the governor.

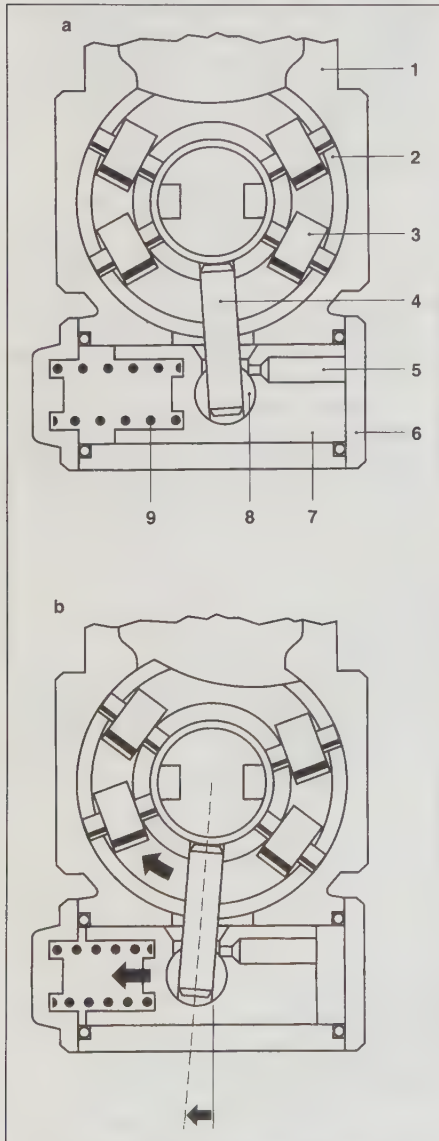
31 Positive torque control via the delivery valves is achieved by having an extra collar on

the valve plungers (see illustration). The collar has flats ground on it. These flats offer little resistance to fuel flow at low speeds, but with increasing flow, their effect is greater and delivery is reduced.

32 Positive torque control via the governor is achieved using an extra lever and spring (see illustration). Above a certain speed, the sliding sleeve force begins to overcome the torque control spring force. The torque control lever then moves relative to the starting lever, with which it shares a pivot, and the tensioning lever moves in the direction of reduced delivery.

Negative torque control

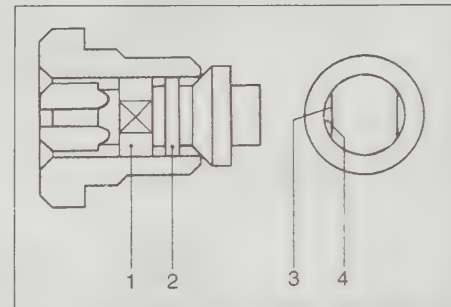
33 Negative torque control is only achieved via the governor. As with positive torque



6.27 Bosch VE pump timing advance device

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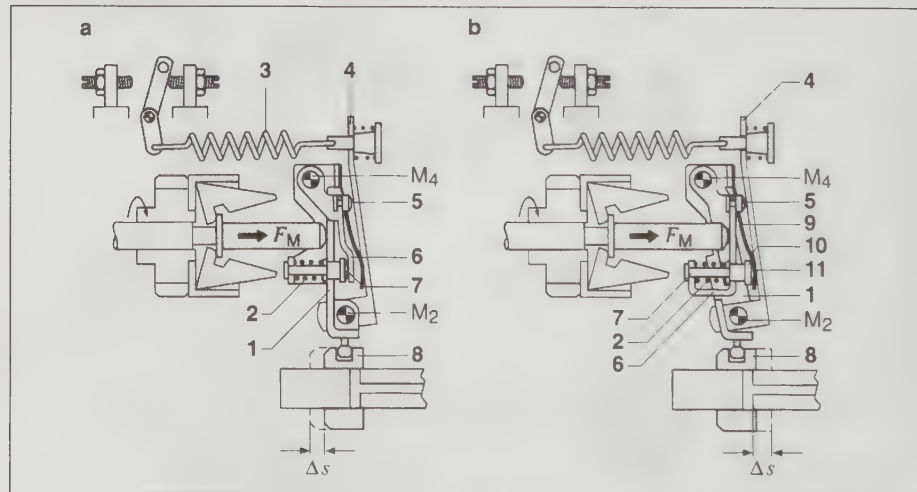
- | | |
|----------------|---------------------------|
| a At rest | 5 Bore in timing position |
| b Running | 6 Cover |
| 1 Pump housing | 7 Timing piston |
| 2 Roller ring | 8 Sliding block |
| 3 Rollers | 9 Spring |
| 4 Pin | |



6.31 Bosch VE pump delivery valve with positive torque control

© Robert Bosch Limited

- | |
|--------------------------------|
| 1 Relief collar |
| 2 Torque control collar |
| 3 Flats |
| 4 Cross-section of restriction |



6.32 Bosch VE pump torque control by means of the governor

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- | | | |
|---------------------------|------------------------|--|
| a Positive torque control | 6 Torque control lever | M_2 Pivot point for starting and tensioning levers |
| b Negative torque control | 7 Torque control pin | M_4 Pivot point for starting and torque control levers |
| 1 Starting lever | 8 Control spool | F_M Sleeve force |
| 2 Torque control spring | 9 Starting spring | Δs Control spool travel |
| 3 Governor spring | 10 Pin collar | |
| 4 Tensioning lever | 11 Stop point | |
| 5 Lug | | |

control, an extra lever and spring are fitted, but the arrangement is such that when the spring pressure is overcome, the lever assembly moves to increase delivery.

Manifold pressure compensation (LDA)

34 Manifold pressure compensation is necessary on turbocharged engines, because fuel requirement varies not only with speed, but also in proportion to inlet manifold pressure (boost).

35 In practice, the pump is set to deliver the optimum amount of fuel for maximum boost; the manifold pressure compensator reduces fuel delivery at lower boost pressures. For this reason, it is sometimes known as a *smoke limiter*, since without it the engine would smoke excessively under part-load conditions.

36 The manifold pressure compensator is mounted on top of the pump (see illustration). It contains a flexible diaphragm, which is subject to spring (and atmospheric) pressure on one side, and to inlet manifold pressure on the other. Movement of the diaphragm is transmitted by a sliding pin and a guide pin to a stop lever, which alters the full-load stop position of the governor.

37 When the engine speed is low, the inlet manifold pressure is not sufficient to move the diaphragm against spring force. The sliding pin is in the high position, displacing the guide pin and the stop lever towards reduced fuel delivery.

38 As speed and manifold pressure rise, the diaphragm is forced downwards. The guide pin moves into the waisted section of the sliding pin, and the stop lever moved to increase fuel delivery.

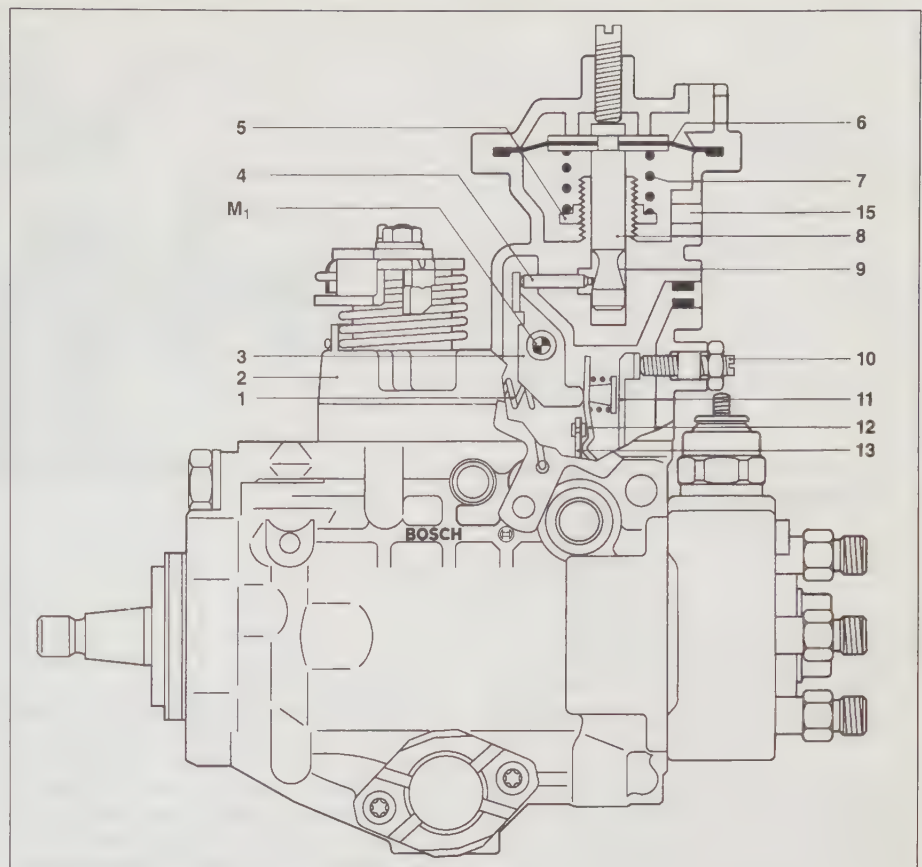
39 If the turbocharger fails, boost pressure will be zero, and the diaphragm will resume its low-pressure position. The engine will operate normally, whereas (without the pressure compensation) it would receive too much fuel, and produce smoke.

Load-dependent injection timing (LFB)

40 Smoother engine operation can be achieved if injection timing is retarded when load is reduced, and advanced when it is increased. This function can be carried out by the governor as follows.

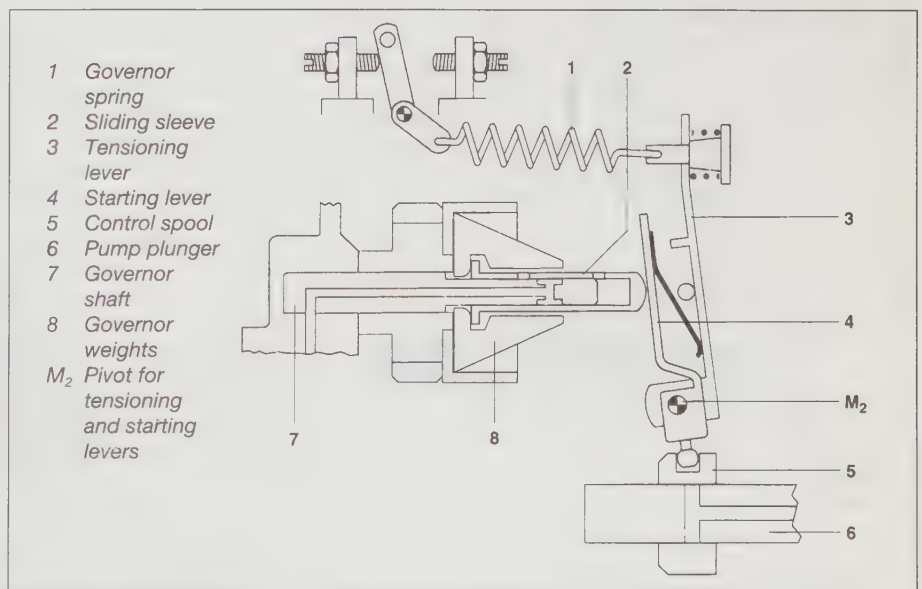
41 A transverse bore in the governor sliding sleeve opens and closes a similar bore in the governor shaft (see illustration). The governor shaft bore communicates with the inlet (suction) side of the supply pump. When the sleeve and shaft bores coincide, fuel flows out, and pump cavity pressure is reduced. Since pump cavity pressure controls injection advance, reducing the pressure retards the injection timing.

42 When the engine is running under a load which reduces without the speed control lever being moved, engine speed will tend to increase. The governor weights will move out, and the sliding sleeve will move, uncovering



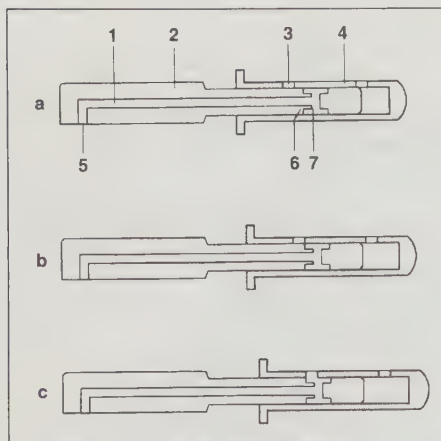
6.36 Bosch VE pump with manifold pressure compensation

© Robert Bosch Limited	5 Adjusting nut	10 Full-load adjusting screw
1 Governor spring	6 Diaphragm	11 Adjusting lever
2 Governor cover	7 Spring	12 Tensioning lever
3 Stop lever	8 Sliding pin	13 Starting lever
4 Guide pin	9 Waisted section	M ₁ Pivot for stop lever



6.41 Sectional view of Bosch VE pump load-dependant injection timing device

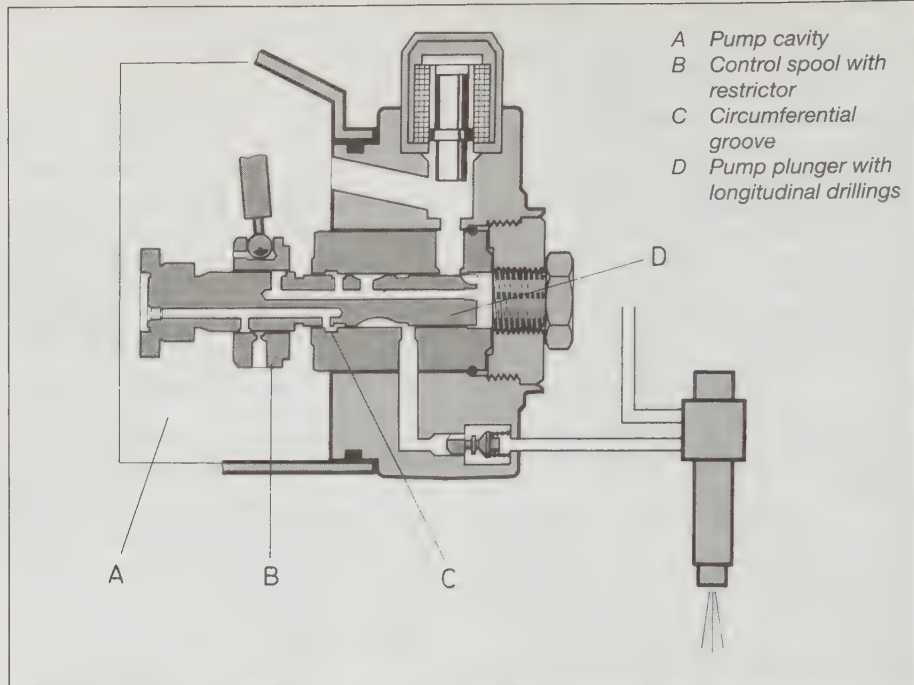
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6.42 Positions of load-dependant device sliding sleeve – Bosch VE pump

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- | | |
|---------------------------------------|-------------------------------------|
| a Initial | 4 Sliding sleeve |
| b About to open | 5 Transverse bore in governor shaft |
| c Open | 6 Governor shaft port |
| 1 Longitudinal bore in governor shaft | 7 Transverse bore in governor shaft |
| 2 Governor shaft | |
| 3 Transverse bore in sliding sleeve | |



6.47 Sectional view of pump plunger and associated components – Bosch VE pump with integral quiet-running device

the bore in the governor shaft (**see illustration**). Pump cavity pressure will reduce, and the injection timing will be retarded.

43 If the load increases and the speed control lever is not moved, engine speed will tend to fall. As the weights move inwards and the sleeve retracts, the bores will no longer coincide. Fuel ceases to flow out of the pump cavity, pressure will increase, and the injection timing will be advanced.

Altitude compensation (ADA)

44 Altitude compensation involves reducing the full-load delivery with increasing altitudes, to compensate for the reduced density of the air. It is not normally found on UK models, though it is used elsewhere in Europe.

45 Operation of the altitude compensator is similar to that of the manifold pressure

compensator described earlier. The altitude compensator contains a vacuum (aneroid) capsule, which moves a sliding pin under the influence of changing atmospheric pressure. The sliding pin is connected to a stop lever, positioned so that a reduction in atmospheric pressure reduces maximum fuel delivery.

Integral quiet-running device

46 This device is fitted to some VW models. Its aim is to reduce engine noise at idle. It does this by lengthening the period over which the fuel is injected.

47 Pumps having this device are provided with an extra longitudinal drilling in the pump plunger, a restricted outlet bore in the control spool, and a circumferential groove in the distributor head (**see illustration**).

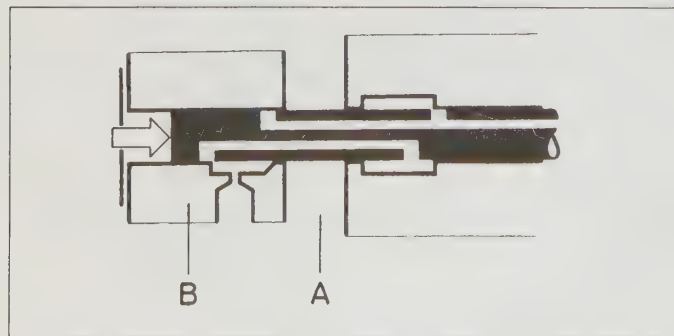
48 At idle, a proportion of the fuel which would normally be injected is instead

discharged back into the pump cavity via the restricted outlet bore in the control spool (**see illustration**). This delays the rise in injection pressure. The discharge only takes place while the two longitudinal drillings are in communication via the circumferential groove. Movement of the pump plunger towards TDC breaks this communication, and the later phase of injection takes place as normal.

49 The device has no effect when the engine is under load, because movement of the control spool to increase delivery results in the two drillings no longer being in communication (**see illustration**).

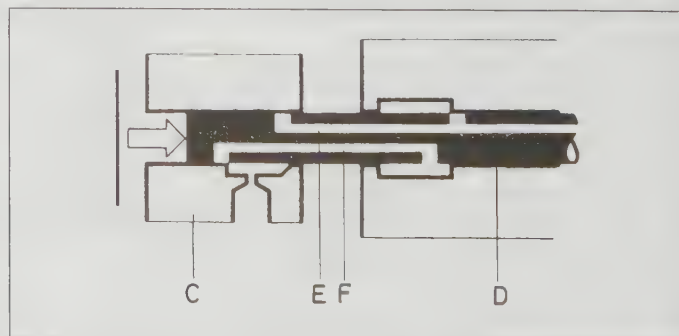
Cold start devices

50 Cold start devices all advance injection timing, either automatically or in response to a mechanical cold start control. Advance may be achieved mechanically (by moving the



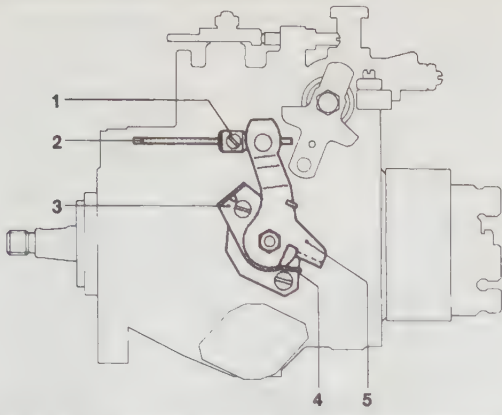
6.48 Integral quiet-running device operation at idle – Bosch VE pump

- A Pump cavity B Control spool with restrictor



6.49 Integral quiet-running device under load – Bosch VE pump

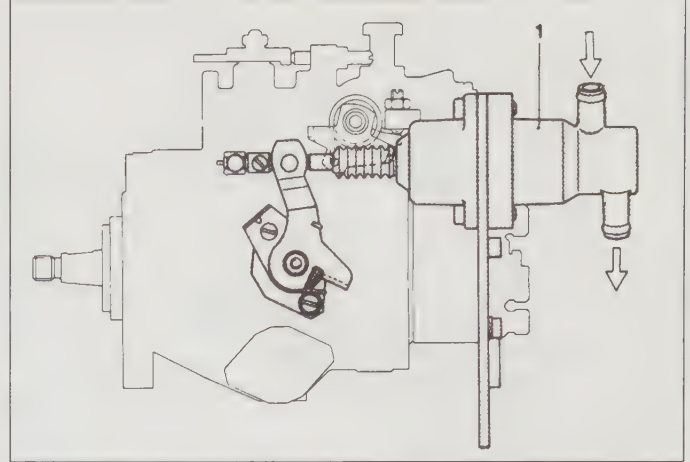
- C Control spool with restrictor E Longitudinal drilling 1
D Pump plunger F Longitudinal drilling 2



6.52a Manually-operated cold start injection advance – Bosch VE pump

© Robert Bosch Limited

- | | | |
|---------|----------|-----------------|
| 1 Screw | 3 Stop | 5 Advance lever |
| 2 Cable | 4 Spring | |



6.52b Automatically-operated cold start injection advance – Bosch VE pump

© Robert Bosch Limited
1 Actuator

roller ring or the timing advance piston) or hydraulically (by increasing pump cavity pressure).

51 Additional devices associated with the basic cold start device may inhibit the starting delivery of fuel when the engine is warm, and increase idle speed when it is cold.

Mechanical cold start injection advance (KSB)

52 Actuation of the mechanical advance system may be automatic (by connection to a temperature-sensitive control unit plumbed into the cooling system) or manual (dashboard cold start control). In either case, the

mechanism inside the pump is the same (see illustrations).

53 An advance lever on the outside of the pump turns a shaft which enters the pump cavity. The inner end of the shaft carries an eccentrically-mounted ball-pin, which engages with a slot in the roller ring or the timing advance piston (see illustration).

54 Movement of the advance lever to the cold start position causes a movement of the roller ring or timing advance piston in the direction of increasing advance. The ball-pin and slot allow normal movement of the roller ring to take place as engine speed rises.

55 As the engine warms up, the advance

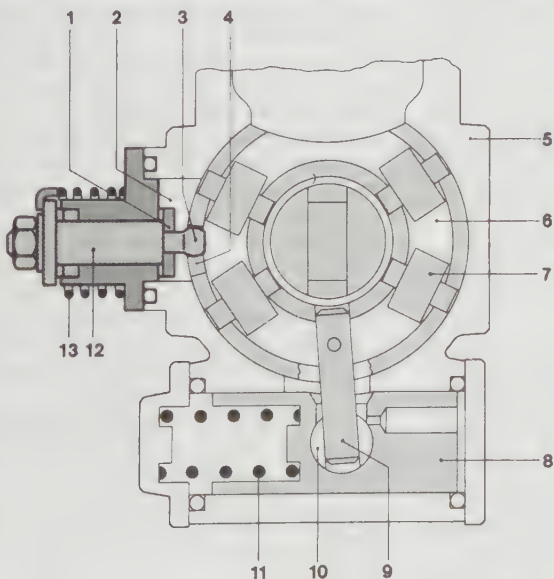
lever is returned to the 'hot' position by the control unit element expanding, or by the driver pushing home the cold start control.

Temperature-dependent starting delivery control (TAS)

56 This system can be combined with mechanical cold-start injection advance. A linkage from the cold start advance mechanism changes the position of a stop lever so that maximum starting delivery of fuel only occurs on a cold engine, when it is required (see illustration).

Temperature-dependent fast idle (TLA)

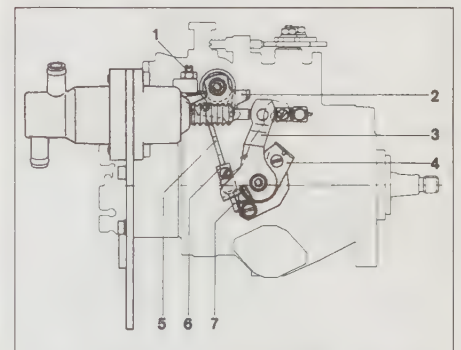
57 This system is also linked with mechanical cold start injection advance. A linkage from the cold start advance mechanism lifts the engine speed control lever off the idle stop when the mechanism is in the 'cold' position. When the engine warms up and the



6.53 Sectional view of cold start advance mechanism – Bosch VE pump

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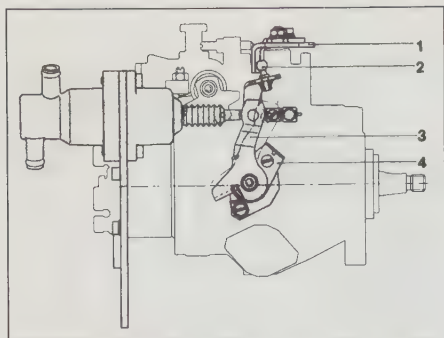
- | |
|-------------------------|
| 1 Lever |
| 2 Access hole |
| 3 Ball-pin |
| 4 Slot in roller ring |
| 5 Pump housing |
| 6 Roller ring |
| 7 Roller |
| 8 Timing advance piston |
| 9 Pin |
| 10 Sliding block |
| 11 Spring |
| 12 Shaft |
| 13 Spring |



6.56 Temperature-dependant starting delivery control – Bosch VE pump

© Robert Bosch Limited

- | | |
|--------------------|-------------------|
| 1 Stop screw | 5 Reduction lever |
| 2 Outer stop screw | 6 Retaining pin |
| 3 Advance lever | 7 Locating pin |
| 4 Stop | |



6.57 Temperature-dependant fast idle – Bosch VE pump

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- 1 Pump control lever
- 2 Ball-pin
- 3 Advance lever
- 4 Stop

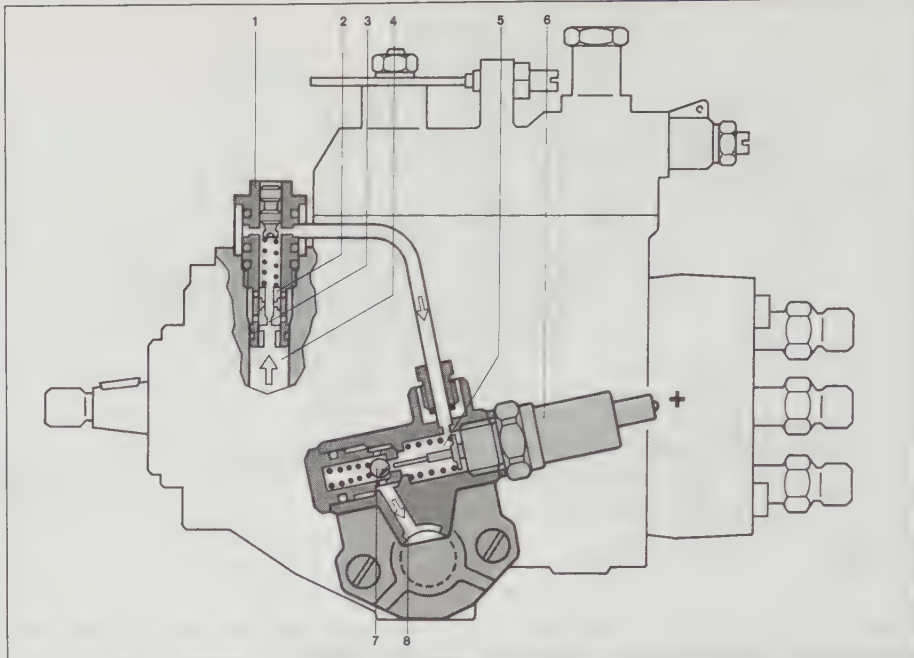
mechanism is returned to the 'hot' position, normal idle speed is restored (see illustration).

Hydraulic cold start injection advance (KSB)

58 Hydraulic cold start injection advance works by increasing pump cavity pressure when the engine is cold. This is achieved by a pressure-holding valve, which is opened by the warming up of an electrically-heated expansion element (see illustration).

59 When the engine is started from cold, the expansion element is cold and the pressure-holding valve is closed. A restriction bore in the pump pressure control valve raises the pump cavity pressure and injection timing is advanced.

60 When the engine is running, the expansion element is heated electrically. When it has warmed up sufficiently, it opens the pressure-holding valve which relieves the



6.58 Hydraulic cold start injection advance – Bosch VE pump

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- | | | |
|--------------------------|--------------------------|-------------------|
| 1 Pressure control valve | 4 Pump cavity pressure | 7 Ball valve |
| 2 Piston | 5 Pressure-holding valve | 8 Fuel drain |
| 3 Restrictor | 6 Expansion element | + Electrical feed |

restriction in the pressure control valve. Pump cavity pressure returns to normal.

Engine shut-off

61 A diesel engine is shut off by physically cutting off the fuel supply. This can be done mechanically or electrically. Electrical control is preferred for passenger cars, because it can be operated through the 'ignition' switch instead of using a separate stop control.

62 Electric shut-off is achieved using a solenoid valve which opens the inlet bore to the high-pressure chamber when energised (ignition on) (see illustration). When the electrical supply is removed, the valve closes the inlet so that fuel cannot reach the pump plunger.

63 Mechanical shut-off is achieved using an external stop lever which is cable-actuated by a dashboard control. The lever turns a shaft, at the other end of which is an internal stop lever. The internal stop lever presses against the governor starting lever and forces the control spool into the 'stop' position, opening the cut-off bore in the pump plunger.

64 A mechanical shut-off lever is still fitted to some pumps with electric shut-off, for use in case the solenoid valve jams open. (If the valve jams shut, or its electrical supply is interrupted, the engine will not run at all).

Variable-speed governor (Bosch VE pump)

65 The governor assembly is driven by a gear on the pump input shaft. It consists of a pair

of centrifugal weights on a shaft, several springs, and a lever assembly.

66 The lever assembly consists of two levers: the tensioning lever and the starting lever. The levers have a common pivot. The bottom of the starting lever engages with the control spool. Between the two levers there is a spring (the starting spring) which tends to force them apart.

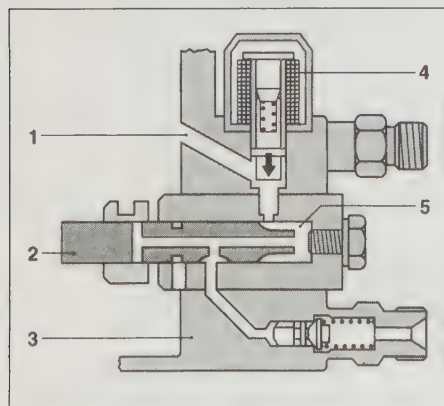
67 A pin passes through the top of the tensioning lever. One end of the governor spring is connected to the pin, the other end being connected to the engine speed control lever. Between the head of the pin and the tensioning lever is another spring, known as the *idle spring*.

68 Radial movement of the weights is converted into linear movement of a sliding sleeve on the governor shaft. Movement of the sleeve, which is opposed by the tension of the springs, is transmitted by the lever assembly to the control spool, and so varies the working stroke of the pump.

69 Control spool position is thus determined by the balance of forces exerted in one direction (towards reduced delivery) by the sliding sleeve, and in the other direction (towards increased delivery) by the springs.

Starting

70 With the centrifugal weights stationary, the sliding sleeve is in its rest position (fully retracted). The starting spring forces



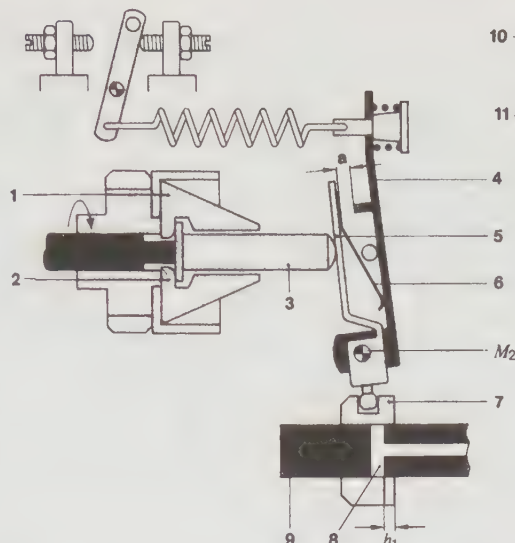
6.62 Sectional view of shut-off solenoid – Bosch VE pump

© Robert Bosch Limited

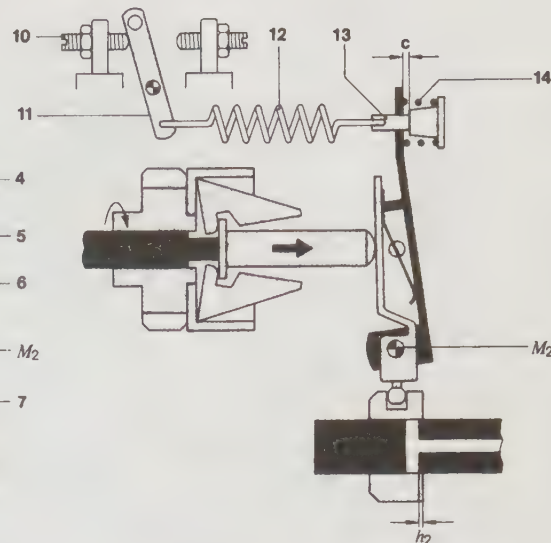
- | | |
|--------------------|-------------------------|
| 1 Fuel inlet | 4 Shut-off solenoid |
| 2 Pump plunger | 5 High-pressure chamber |
| 3 Distributor head | |

- 1 Centrifugal weight
- 2 Centrifugal weight
- 3 Sliding sleeve
- 4 Tensioning lever
- 5 Starting lever
- 6 Starting spring
- 7 Control spool
- 8 Cut-off bore
- 9 Pump plunger
- 10 Idle speed adjusting screw
- 11 Speed control lever
- 12 Governor main spring
- 13 Pin
- 14 Idle spring
- a Starting spring compression
- c Idle spring compression
- h_1 Maximum delivery stroke (starting)
- h_2 Minimum delivery stroke (idling)
- M_2 Pivot for tensioning and starting levers

Starting position.



Idle position.



6.70 Starting and idling positions of Bosch VE pump variable-speed governor

© Robert Bosch Limited

the starting lever away from the tensioning lever, and the control spool is moved to the maximum-delivery position (see illustration).

71 As soon as the engine is turning, the weights start to move outwards. The sliding sleeve presses on the starting lever and overcomes the resistance of the starting spring, forcing the starting lever back into contact with the tensioning lever. The movement of the starting lever is transmitted to the control spool, which is moved into a reduced-delivery position. From now on, the starting lever and the tensioning lever move as one.

Idling

72 With the engine running and the accelerator pedal released, the engine speed control lever rests against the end of the idle speed control screw. The idle spring acts to move the tensioning lever in the direction of increased delivery, in opposition to the force exerted by the sliding sleeve.

73 If the engine speed increases, the weights will move outwards, and the sliding sleeve will move the tensioning lever in the direction of reduced fuel delivery. If the speed falls, the weights will move inwards, and the idle spring

will move the lever in the direction of increased delivery.

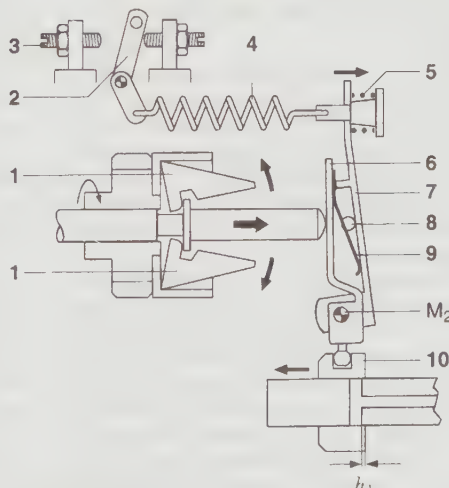
On the road

74 When the accelerator pedal is depressed, the engine speed control lever pulls on the governor spring. This overcomes the force of the idle spring, and also increases the spring tension on the lever assembly. The lever assembly moves the control spool to increase fuel delivery, and engine speed rises.

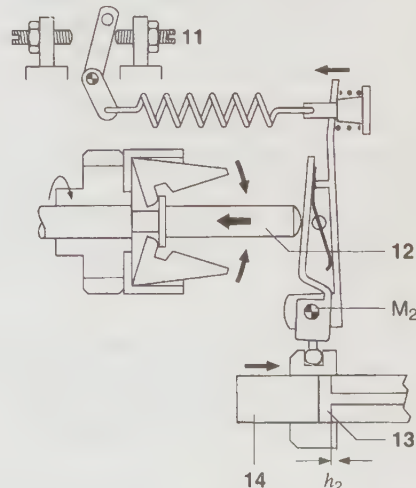
75 The rising engine speed causes the governor weights to move further outwards (see illustration). The sliding sleeve begins to

- 1 Centrifugal weights
- 2 Speed control lever
- 3 Idle speed adjusting screw
- 4 Governor main spring
- 5 Idle spring
- 6 Starting lever
- 7 Tensioning lever
- 8 Tensioning lever stop
- 9 Starting spring
- 10 Control spool
- 11 Maximum speed adjusting screw
- 12 Sliding sleeve
- 13 Cut-off bore
- 14 Pump plunger
- h_1 Full-load delivery stroke (increasing speed)
- h_2 Full-load delivery stroke (decreasing speed)
- M_2 Pivot for starting and tensioning levers

Increasing engine speed

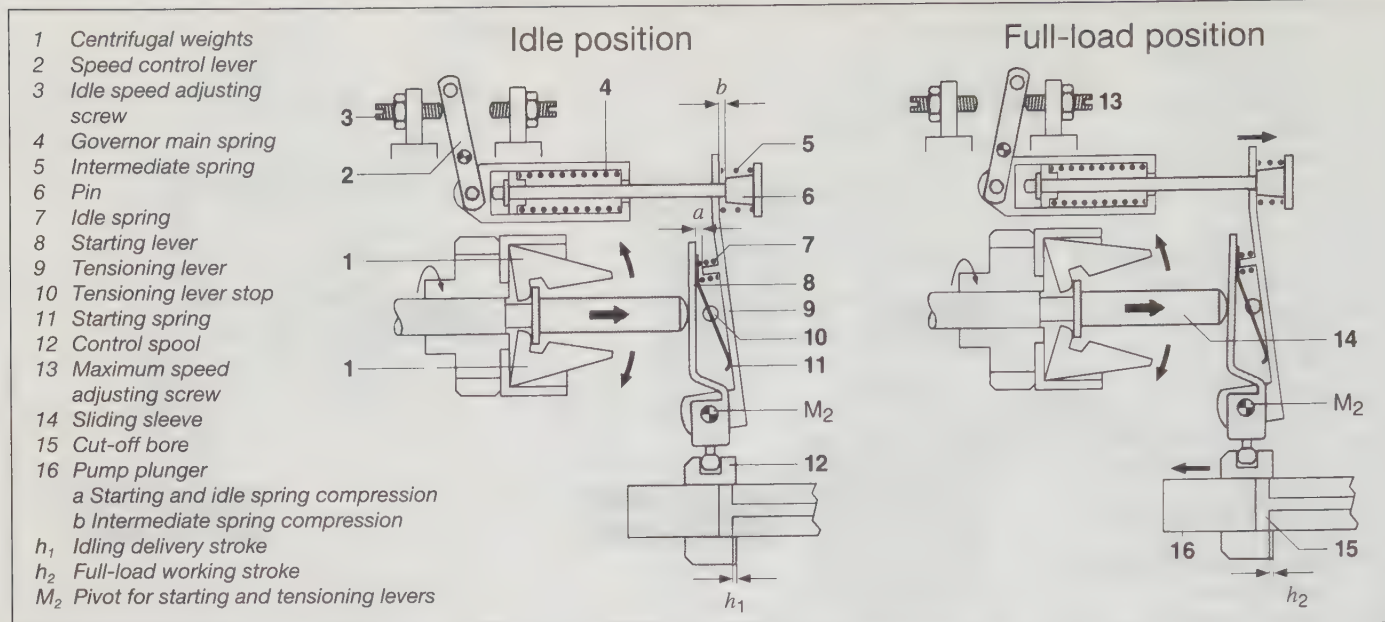


Decreasing engine speed



6.75 Bosch VE pump variable speed governor action with increasing and decreasing speed

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6.82 Bosch VE pump 2-speed governor at idle and under load

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oppose the increased spring tension. The lever assembly is moved back towards reduced fuel delivery, until the force of the sliding sleeve and the force of the governor spring are once more in balance. If the load is constant, engine speed and fuel delivery will stabilise at this new level.

76 If the load on the engine is now reduced – for instance, because the top of a hill has been reached – the speed will begin to increase, because the same amount of fuel is being delivered. The increased speed will move the weights outwards, and the lever assembly will be moved further towards reduced delivery until the balance of forces is restored.

77 If the engine load is removed completely – for instance when going downhill and using the engine as a brake – the governor spring tension is at a minimum. The force of the sliding sleeve predominates, and moves the lever assembly into the minimum-delivery position. If the engine speed approaches the maximum no-load speed, delivery is reduced to zero.

Two-speed governor (Bosch VE pump)

78 This type of governor is only active at idle and maximum speeds. Intermediate speeds are controlled directly by the position of the accelerator pedal.

79 The construction of the governor is very similar to the variable-speed governor just described. The main difference is in the governor spring, which is a compression spring, working inside a guide. The pin at the top of the tensioning lever extends into the spring guide.

Starting

80 With the centrifugal weights stationary, the sliding sleeve is in its rest position (fully

retracted). The starting spring forces the starting lever away from the tensioning lever, and the control spool is moved to the maximum-delivery position.

81 Once the engine is turning and the accelerator pedal is released, the centrifugal weights move outwards, and the sliding sleeve moves to overcome the force of the starting spring. The control spool is moved to the idle-delivery position.

Idling

82 The idle spring on this governor is located between the tension lever and the starting lever. The principle of operation remains the same: spring force and sliding force are opposed and in balance at the set idle speed. The starting spring is also contributing something to the total spring tension (see illustration).

On the road

83 As the accelerator pedal is depressed, the engine speed control lever moves and overcomes the force of the starting and idle springs. Force is exerted on the tensioning lever via the intermediate spring. The intermediate spring serves to cushion the transition from governed to ungoverned operation.

84 Further depression of the accelerator pedal overcomes the force of the intermediate spring. The lever assembly moves directly in accordance with the accelerator pedal position. The governor spring and guide act as a rigid coupling at intermediate speeds.

85 As the engine speed approaches maximum, the sliding sleeve force increases enough to be able to overcome the force of the governor spring. The spring is compressed, and the lever assembly moves to reduce fuel delivery.

LUCAS/CAV DP PUMPS AND GOVERNORS

Lucas/CAV DP pumps

Source and maker's name

86 DP series pumps are made in various European countries by the Lucas group of companies. Depending on age and source, pumps will be found bearing the following makers' names, sometimes in combination:

CAV
 ConDiesel
 Lucas
 RotoDiesel

87 Various different types of pumps may be encountered, but the types which will be found most commonly on passenger and light commercial vehicles are the DPA, DPS and DPC, and these will be described in detail in this Section (see illustration). There are various differences between the three types, but the basic principles of operation common to them all will be described first.

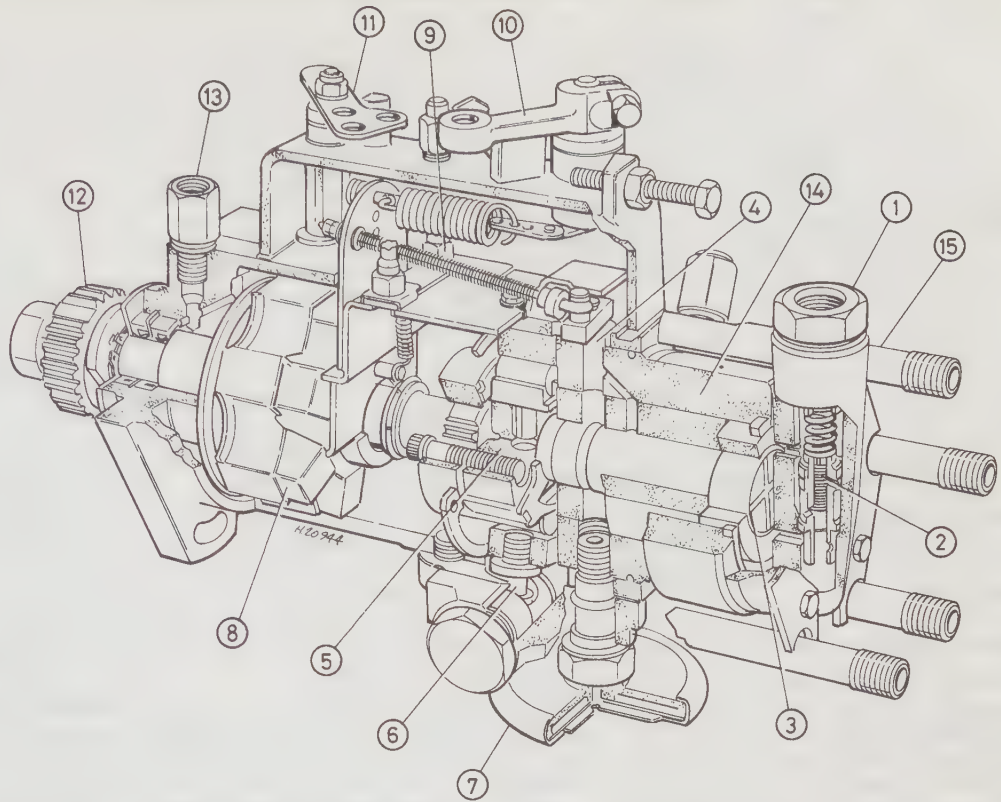
Basic principles

88 The DP series pumps are self-contained distributor pumps, with integral transfer pump and governor, suitable for high-speed diesel engines. The pumps are flange-mounted, and may be driven by gear or sprocket. Lubrication is entirely by the fuel passing through the pump.

89 The pump draws in fuel by means of its transfer pump, which is of the sliding vane type. A high-pressure pump element produces the pressure necessary for injection. Fuel at high pressure is directed to each outlet port in turn by the movement of the pump rotor in the hydraulic head.

90 A proportion of the fuel is not injected, but

- 1 Fuel inlet
- 2 Transfer pressure regulating valve
- 3 Transfer pump
- 4 Metering valve
- 5 High-pressure pump
- 6 Injection timing piston
- 7 Damper
- 8 Governor weights
- 9 Governor linkage
- 10 Speed control (throttle) lever
- 11 Stop lever
- 12 Drivegear
- 13 Fuel return
- 14 Hydraulic head
- 15 High-pressure outlet



6.87 Cutaway view of a Lucas/CAV DPA pump with mechanical governor

returns to the fuel tank along with leaked-off fuel from the injectors. A spring-loaded valve maintains a residual pressure (known as *internal pressure* or *cam box pressure*) in the fuel destined to be returned; this pressure serves to keep air, dirt and water out of the pump, and contributes to smooth operation of the governor.

Transfer pump

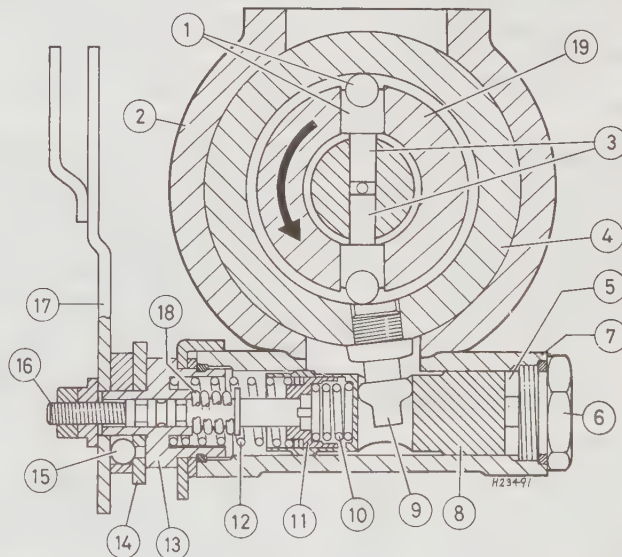
91 Fuel is drawn in by the transfer pump, and pressurised to a value determined by a regulating valve on the pump endplate. This value, known as *transfer pressure*, varies in relation to pump speed.

Metering valve

92 Fuel at transfer pressure is passed to the high-pressure pump via a metering valve. The metering valve opens and closes in response to control lever position and to the governor. Between the metering valve and the high-pressure pump, the fuel is said to be at *metering pressure*.

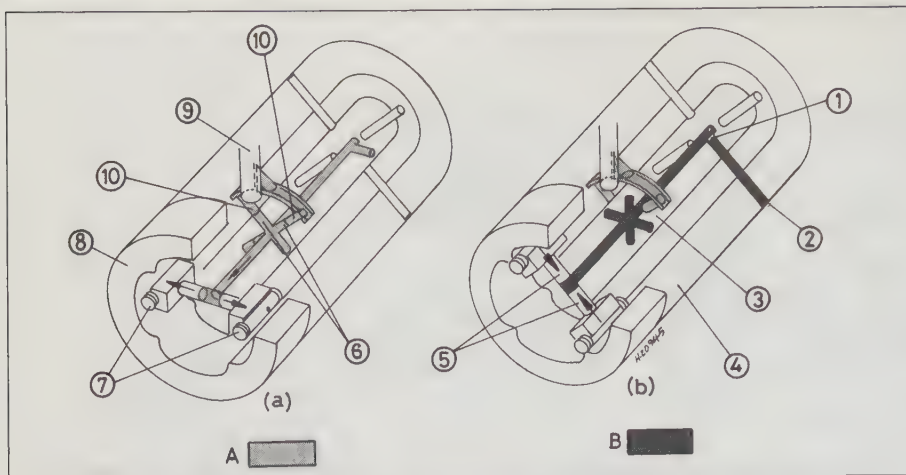
High-pressure pump

93 The high-pressure pumping element consists of a pair of opposed plungers working in a common bore contained in the pump rotor (see illustration). The outer ends of the plungers rest on rollers running in a cam ring. As the rotor is turned by the pump driveshaft, the cam lobes act on the rollers, and the plungers are forced towards each other.



6.93 High-pressure pump and automatic advance mechanism with manual advance lever – Lucas/CAV DPA pump

- | | | |
|-------------------------------|--------------------------|-------------------------|
| 1 Roller and shoe | 6 Plug | 13 End cap |
| 2 Pump housing | 7 Advance piston housing | 14 Detent plates |
| 3 High-pressure pump plungers | 8 Advance piston | 15 Ball |
| 4 Cam ring | 9 Advance screw | 16 Spindle |
| 5 Transfer pressure chamber | 10 Retard spring | 17 Manual advance lever |
| | 11 Plunger | 18 Spindle spring |
| | 12 Advance spring | 19 Rotor |



6.100 Fuel charging (a) and injection (b) – Lucas/CAV DP series pump

- | | | |
|----------------------|------------------|-------------------|
| A Metering pressure | 3 Rotor | 7 Rollers |
| B Injection pressure | 4 Hydraulic head | 8 Cam ring |
| 1 Delivery port | 5 Pump plungers | 9 Metering valves |
| 2 Outlet port | 6 Inlet ports | 10 Metering ports |

Rotor and hydraulic head

94 As well as the high-pressure pump, the rotor contains a number of fuel inlet ports, and a single distributor port. The hydraulic head has a single metering port, and as many outlet ports as there are cylinders. As the rotor turns, the inlet ports align with the metering port, and the distributor port aligns with the outlet ports.

Control of fuel delivery

95 The quantity of fuel delivered per pumping stroke depends on three inter-related factors:

- Metering pressure (varies with transfer pressure and metering valve opening).
- Transfer pressure (increases with pump speed).
- Duration of alignment of inlet port with metering port (reduces pump speed).

96 On some versions of the pump, an auxiliary pair of plungers supplies the excess fuel delivery needed during start-up. Fuel supply to the auxiliary plungers is controlled by an excess-fuel delivery valve, which is closed by the increase in transfer pressure when the engine starts. On other versions, the excess fuel is provided by allowing the plungers to move further apart than normal.

Control of injection timing

97 The cam ring is not fixed, but can be rotated within certain limits by a piston. Movement of the piston is determined by spring pressure on one side, and by fuel transfer pressure on the other side. Increasing transfer pressure moves the cam ring against the direction of pump rotation, so advancing injection timing with increasing speed.

98 This device can only be used to retard the injection timing during start-up, taking advantage of the fact that transfer pressure is zero before start-up, and low at cranking speeds.

99 The timing advance device can be fitted

with an external manual advance control, for improvement of cold idling.

The pump working cycle

100 The movement of the pump rotor brings one or two inlet ports into line with the corresponding metering port(s). Fuel at metering pressure flows into the rotor, and forces the pump plungers apart. The higher the metering pressure, the further the plungers will be moved, and the greater the fuel charge for the forthcoming injection. Except at maximum delivery, the pump plungers will not move out to the limit of their travel before commencing the injection stroke (see illustration).

101 Continued movement of the rotor closes the inlet port. The distributor port comes into line with one of the outlet ports in the hydraulic head; at the same time, the plungers are forced towards each other by the movement of the rollers riding up on the cam ring lobes. The fuel is then pressurised, and injection takes place.

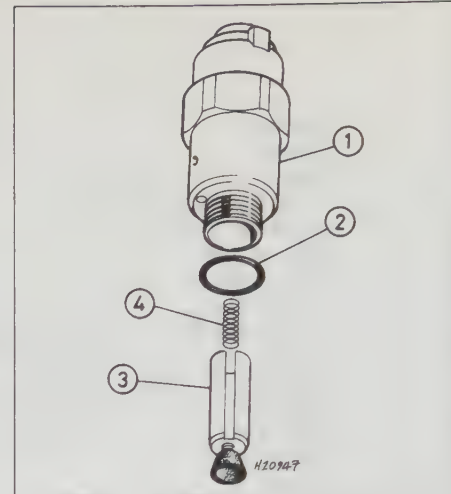
102 Further movement of the rotor takes the distributor port out of alignment with the outlet port. The next inlet port comes into line with the metering port, and the cycle begins again.

Shut-off

103 Mechanical shut-off (when provided) is a function of the governor, and is described later. Electrical shut-off by means of a solenoid is almost universal on modern vehicles.

104 The shut-off solenoid is screwed into the top of the hydraulic head. It contains a spring-loaded plunger, which in its extended position interrupts the fuel passage between the transfer pump and the metering valve (see illustration).

105 When the solenoid is energised, the plunger is retracted, and the fuel at transfer pressure passes to the metering valve. When the 'ignition' is switched off, the spring forces



6.104 Fuel shut-off solenoid – Lucas/CAV DP series pump

- | | |
|--------------|-----------|
| 1 Valve body | 3 Plunger |
| 2 O-ring | 4 Spring |

the plunger out. The fuel passage is interrupted, and the engine stops.

Lucas DPA pump

Description

106 The DPA pump is the earliest and simplest of the DP series. Operation is as described in the preceding paragraphs.

Air venting

107 An external vent screw is fitted, either on the pump top cover (mechanical governor) or on the pump body (hydraulic governor). This screw must be opened when bleeding the fuel system.

Lucas DPS pump

Description

108 The DPS pump is a development of the DPA type, intended specifically for passenger car and light commercial applications (see illustration).

109 The transfer pump and high-pressure pump work on the same principle as those in the DPA pump, but there are detail differences. These are described in the following paragraphs.

Air venting

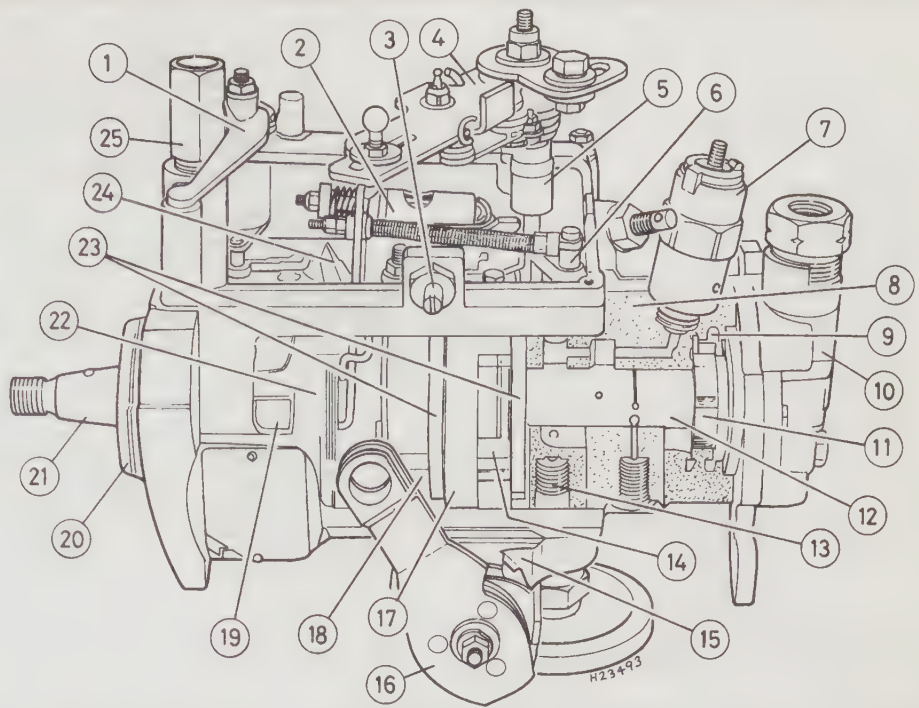
110 Air is automatically bled from the pump at cranking speed. This is achieved by two valves, known as the *latch valve* and the *rotor switch valve*. At cranking speed, the latch valve is closed by a combination of spring pressure and differential fuel pressure. The rotor switch valve is open, allowing fuel and air from the rotor to vent into the pump cam box.

111 With increasing speed, transfer pressure rises and opens the latch valve. The opened latch valve applies transfer pressure to the rotor switch valve, closing it.

Fuel pressure circuits

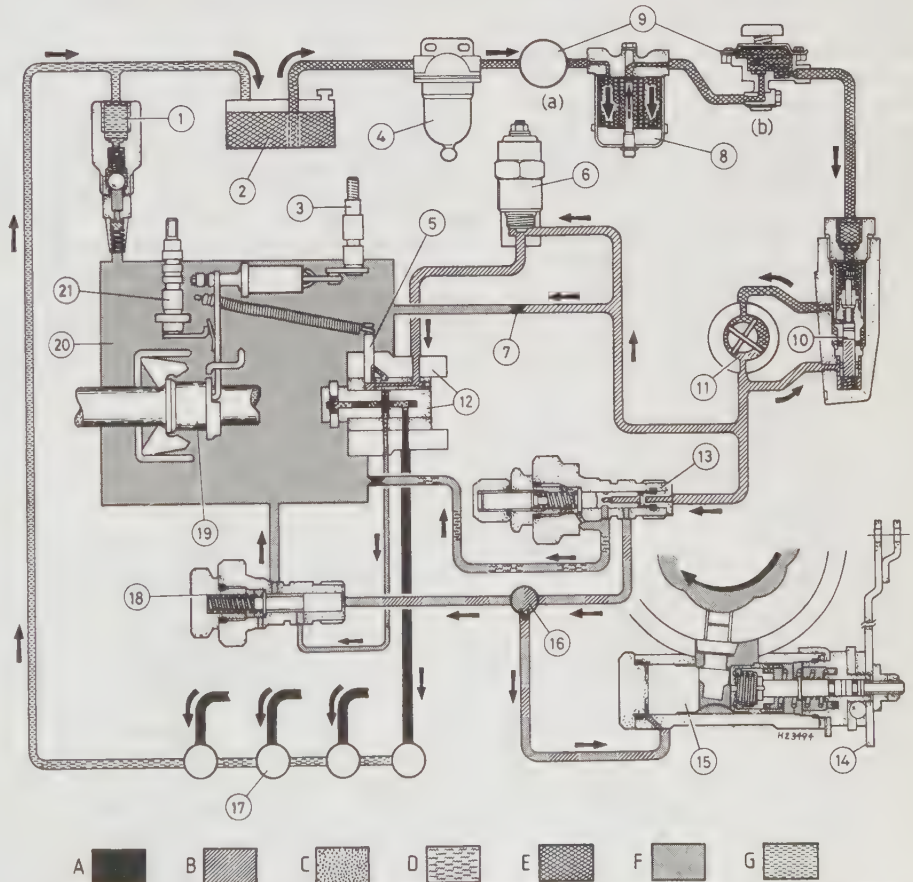
112 These are shown in the accompanying illustration (see illustration). It will be seen

- 1 Idle lever
- 2 Governor main spring
- 3 Maximum fuel adjuster
- 4 Speed control (throttle) lever
- 5 Excess-fuel shaft
- 6 Metering valve
- 7 Shut-off valve
- 8 Hydraulic head
- 9 Venting orifice
- 10 Transfer pressure regulating valve
- 11 Transfer pump
- 12 Rotor
- 13 Head-locating fitting and damper
- 14 Roller and shoe
- 15 Automatic advance unit
- 16 Manual advance lever
- 17 Cam ring
- 18 Driveshaft rear bearing
- 19 Governor weight retainer
- 20 Driveshaft front bearing
- 21 Driveshaft
- 22 Governor thrust sleeve
- 23 Scroll plates
- 24 Idling spring
- 25 Fuel return union and residual pressure valve

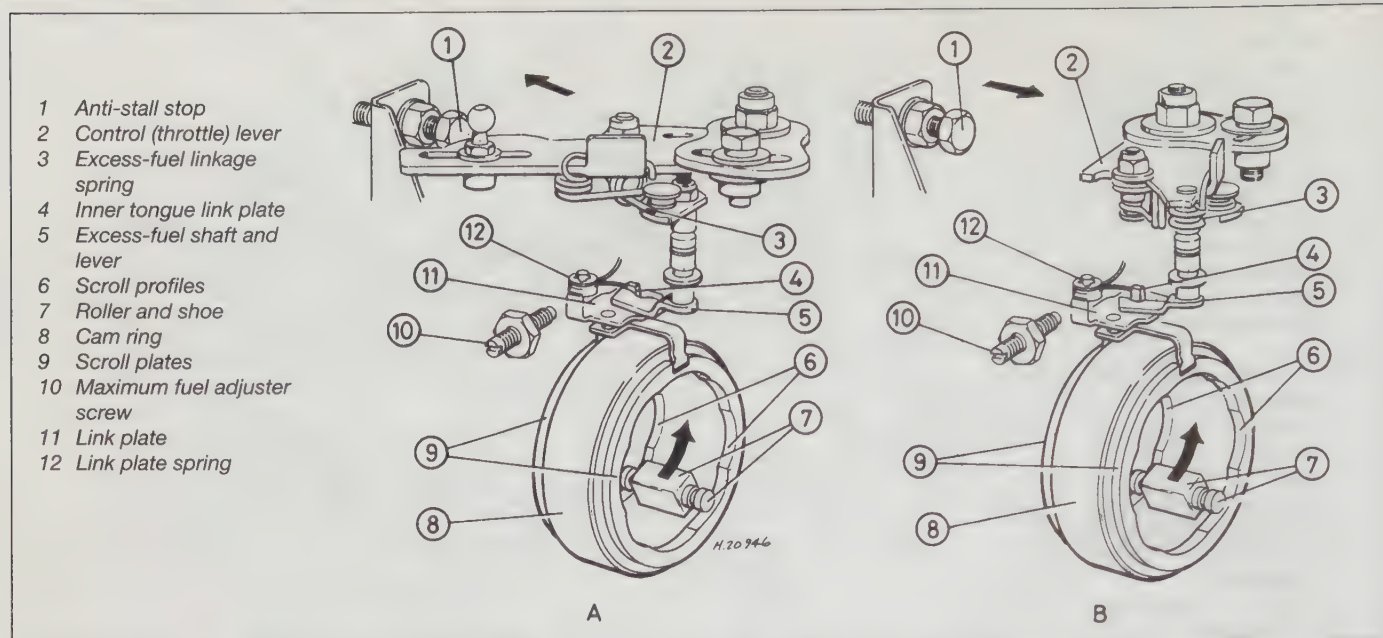


6.108 Cutaway view of Lucas/CAV DPS pump

- A Injection pressure
- B Transfer pressure
- C Metering pressure
- D Differential pressure
- E Feed pressure
- F Cam box (residual) pressure
- G Back leakage (return) pressure
- 1 Residual pressure valve
- 2 Fuel tank
- 3 Control (throttle) lever shaft
- 4 Water trap
- 5 Metering valve
- 6 Shut-off solenoid
- 7 Vent orifice
- 8 Fuel filter
- 9a Lift pump
- 9b Hand-priming pump
- 10 Transfer pressure regulator
- 11 Transfer pump
- 12 Hydraulic head and rotor
- 13 Latch valve
- 14 Manual advance lever
- 15 Advance piston
- 16 Head-locating fitting
- 17 Injector
- 18 Rotor vent switch valve
- 19 Governor
- 20 Cam box
- 21 Idle lever shaft



6.112 Fuel hydraulic pressure diagram – Lucas/CAV DPS pump



6.114 Scroll plate mechanism (Lucas/CAV DPS pump) in excess-delivery position (A) and normal maximum-delivery position (B)

that the opening of the latch valve is used to apply transfer pressure to the automatic advance piston. In this way, injection timing is fully retarded during start-up.

113 Differential fuel pressure is generated at cranking speed by the effect of two restrictors in the latch valve hydraulic circuit. Its effect is to make the speed at which the valve opens higher than that at which it closes. This is necessary to prevent the latch valve closing during rapid deceleration, so retarding the timing.

Excess and maximum fuel delivery

114 Two scroll plates, one on each side of the cam ring, control automatic delivery of excess fuel during start-up, and limit maximum fuel

delivery during normal running (see illustration).

115 At start-up with the accelerator pedal released, the scroll plates are positioned so as to allow the pump plunger rollers to move further apart. The metering valve is open, and excess fuel delivery takes place.

116 As soon as the engine starts, the governor closes the metering valve to the idling position, and excess fuel delivery ceases.

117 During normal running with the accelerator pedal fully depressed, the position of the scroll plates determines the maximum outward movement of the pump plunger rollers, and thus maximum fuel delivery. This position of the scroll plates is determined by a

link plate coming up against the maximum-fuel adjuster screw.

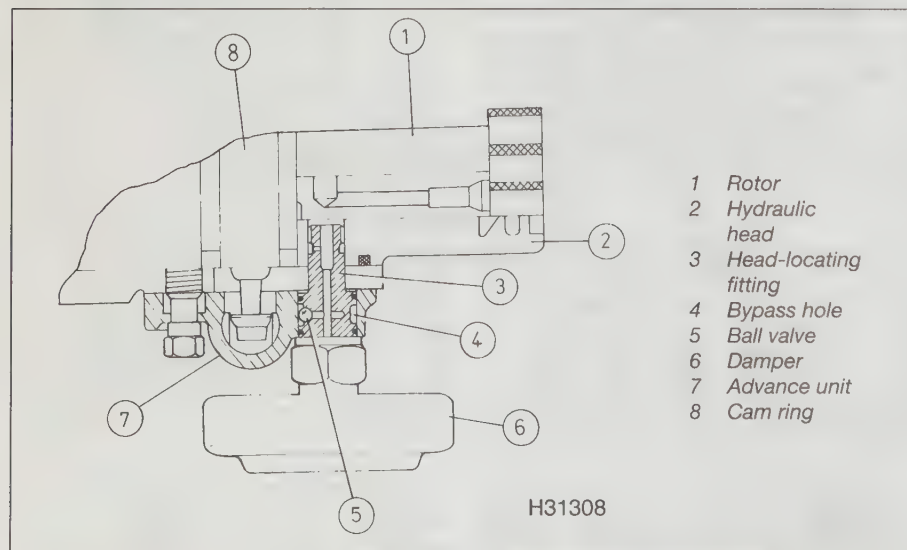
Timing advance device and head-locating fixing

118 The timing advance device is secured to the underside of the pump by a fitting which also serves to locate the hydraulic head in the pump housing (see illustration). This head-locating fitting contains the passages which transmit hydraulic pressure from the head to the advance device.

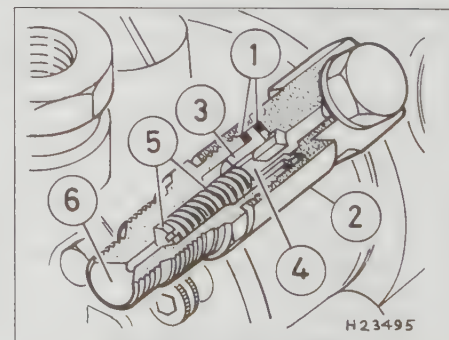
119 The head-locating fitting may also incorporate a damper assembly, to even out fluctuations in transfer pressure.

Delivery valves

120 The delivery valves are fitted around the hydraulic head; each valve connects a high-pressure outlet to its injector pipe (see illustration). The function of the delivery valve

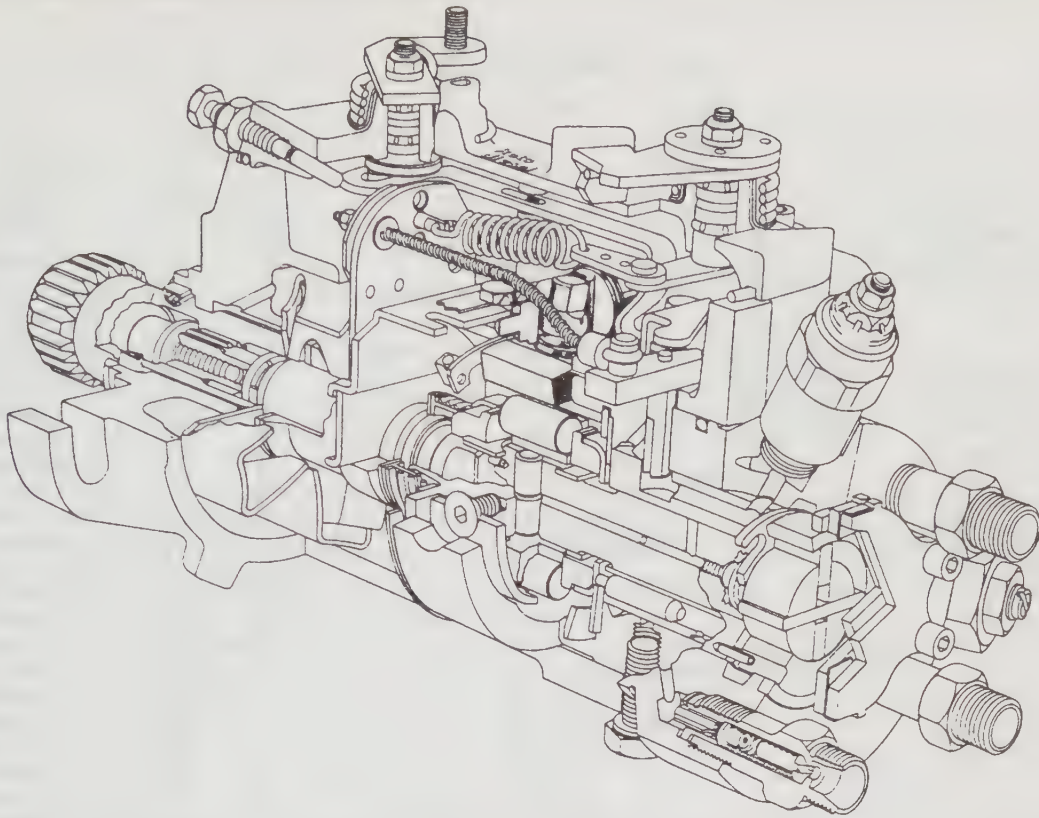


6.118 Head-locating fitting - Lucas/CAV DPS pump



6.120 Cutaway view of a delivery valve - Lucas/CAV DPS pump

- | | |
|--------------------|------------------|
| 1 Washers | 4 Valve piston |
| 2 Banjo connection | 5 Spring and peg |
| 3 Valve body | 6 Valve holder |



6.122 Cutaway view of a Lucas DPC pump

is to ensure a clean cut-off at the end of injection, minimising dribble and smoke. It also maintains a residual pressure in the injector pipes between injections, and protects the pipes against cavitation.

Lucas DPC pump

Description

121 The DPC pump differs from the DPS mainly in the means by which excess fuel delivery is obtained for start-up. It also has a greater variety of governors and advance mechanisms. Versions are available which are suitable for use with turbochargers.

122 Externally, the DPC pump is easily

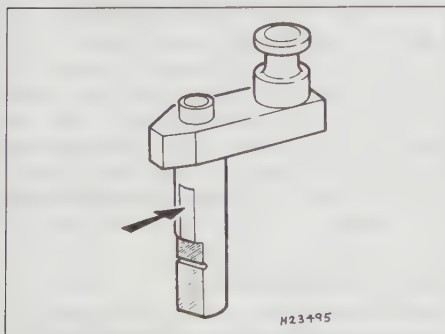
identified by having axial (in-line) high-pressure outlets, as opposed to the radial outlets found on the DPA and DPS pumps (see illustration).

Air venting

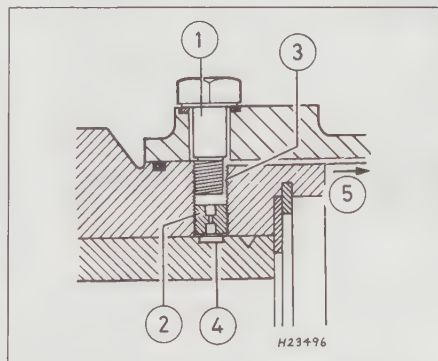
123 Three different self-venting systems exist for this pump. Which one is used will depend on the fitted position of the pump, since air drawn in will accumulate at the highest point, and it is here that venting must take place.

The three venting points are (see illustrations):

- At the metering valve, by means of a flat on the valve shaft.
- Through a jet and flat at the hydraulic head securing screw.
- At the excess-fuel delivery valve.

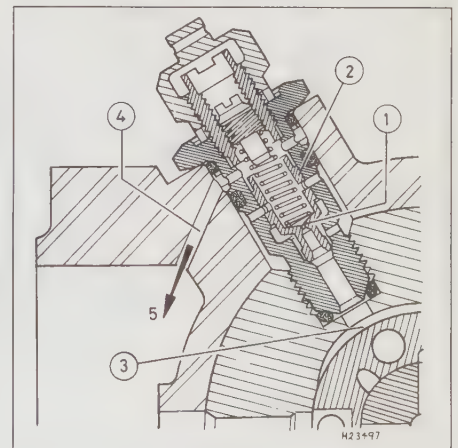


6.123a Venting flat (arrowed) on Lucas DPC pump delivery valve shaft



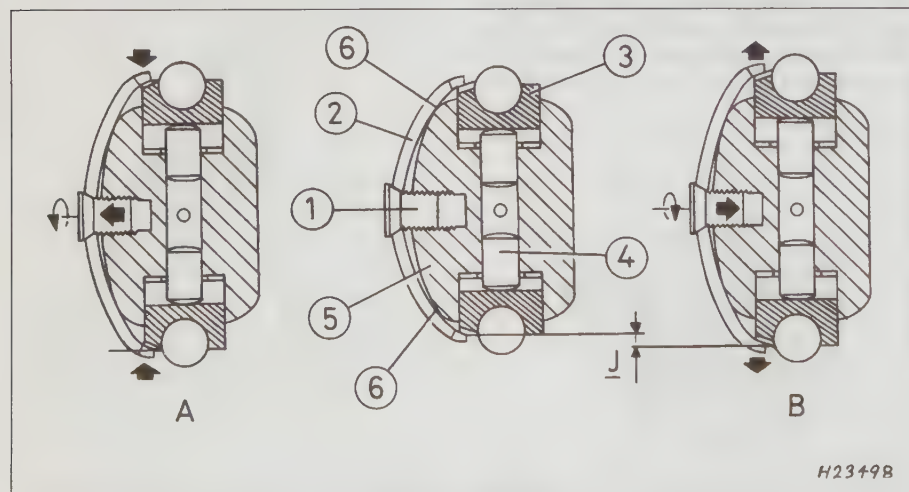
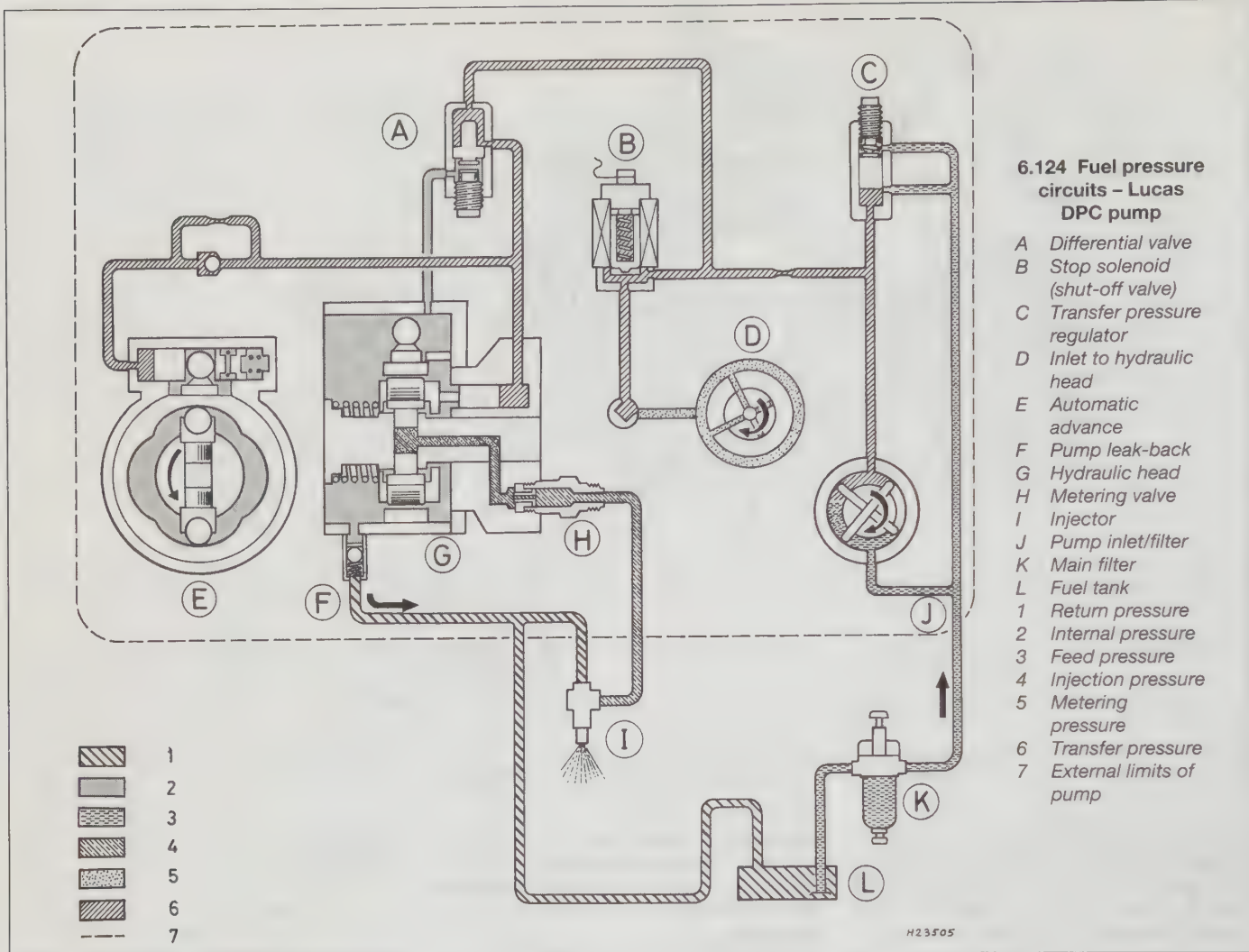
6.123b Venting jet at hydraulic head securing screw - Lucas/CAV DPC pump

- | | |
|-------------------|----------------------------|
| 1 Securing screw | 4 Transfer pressure groove |
| 2 Venting orifice | 5 Back-leakage |
| 3 Flat | |



6.123c Air venting via excess-fuel delivery valve - Lucas/CAV DPC pump

- | | |
|----------------------|----------------------------|
| 1 Calibrated orifice | 3 Transfer pressure groove |
| 2 Valve stem | 4 Passage |
| | 5 Back-leakage |



Fuel pressure circuits

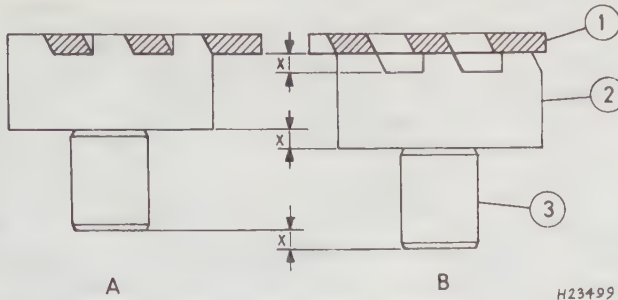
124 The only component unique to the DPC pump is the *differential valve* (also known as the *excess-fuel delivery valve*). This valve controls the operation of the excess-fuel delivery system, as described later (see illustration).

Maximum fuel delivery regulation

125 The outward travel of the plunger roller shoes, and thus the maximum fuel delivery, is limited by the position of a spring strip known as the *maximum fuel adjustment plate*. An adjustment screw increases or decreases the tension of this strip, so moving the ends further apart or closer together (see illustration).

Excess fuel delivery

126 Excess fuel for start-up is obtained by allowing the pump plungers to move further apart. This is achieved by the use of slots and castellations in the plunger roller shoes and

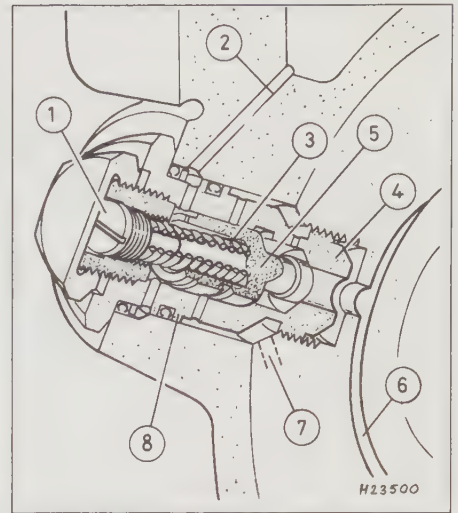


6.126 Excess-fuel delivery slots and castellations - Lucas DPC pump

1 Maximum-fuel adjustment plate

2 Shoe
3 Plunger

A Excess delivery position
B Normal delivery position
X Difference in stroke



6.127 Cutaway view of excess-fuel delivery valve - Lucas DPC pump

1 Adjusting screw

2 Fuel port
3 Return spring
4 Hollow stud
5 Valve stem

6 Transfer pressure groove
7 Port connecting excess-fuel pistons
8 Port connecting hollow stud

the maximum fuel delivery plate (see illustration). If the slots and castellations mesh, the plungers can move further out than if the castellations are in alignment.

127 Meshing of the slots and castellations is controlled by the excess-fuel delivery carriage. This is a mechanism which moves the plunger shoes in or out of mesh, in response to spring pressure on one side of the carriage, and hydraulic pressure on the other side. The application of hydraulic pressure is controlled by the excess-fuel delivery valve (see illustration).

128 With the engine stopped, there is no hydraulic pressure, and the spring holds the carriage in the excess-fuel delivery position. At cranking speed, transfer pressure is too low to open the excess-fuel delivery valve, so the carriage stays in position and excess fuel is delivered (see illustration).

129 When the engine starts, transfer pressure rises to a high enough level to open the excess-fuel delivery valve. This allows transfer pressure to be applied to the excess-fuel delivery pistons, which move the carriage

against spring pressure into the normal delivery position (see illustration).

Control of injection timing

130 The basic automatic advance device is similar to that fitted to the DPS pump, except that the application of transfer pressure is determined by the opening of the excess-fuel delivery valve.

131 Refinements of the basic automatic advance system are described in the following paragraphs.

Manual advance override

132 This is a mechanical device which acts on the spring side of the automatic advance piston. The driver operates a 'cold idling' control which moves a lever on the side of the pump. Movement of the lever pulls the advance piston spring away from the piston, allowing the piston to move further in the advance direction.

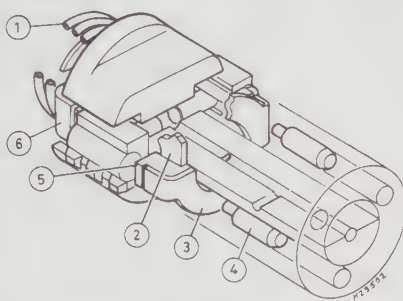
Automatic advance override

133 This system is only fitted in conjunction with the low-load advance system. A

mechanical link between the idle lever and the low-load advance piston allows a spigot on the piston to enter a hole when the lever is in the fast idle (cold start) position. The piston thus moves to reduce spring tension, and allows greater movement of the automatic advance piston (see illustrations).

134 When the accelerator pedal is depressed, load pressure increases, and the low-load advance piston moves off its seat. If the engine is now warm, the idle lever moves away from the fast idle position, and the hole is no longer in alignment with the piston spigot. The advance override is cancelled until the next cold start.

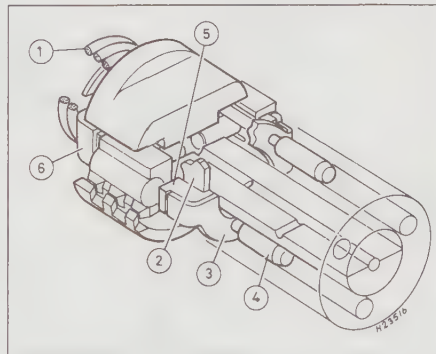
2



6.128 Excess-fuel delivery carriage in excess-fuel delivery position - Lucas DPC pump

1 Spring
2 Spacer
3 Rear retaining plate

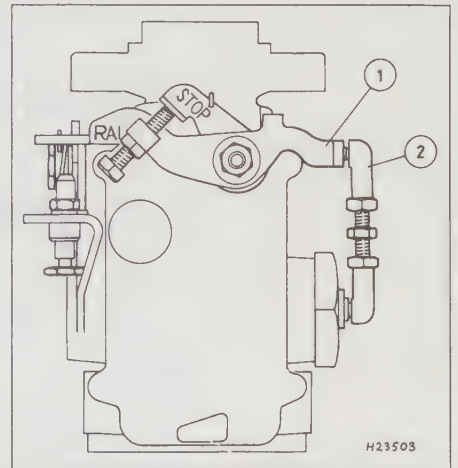
4 Excess-fuel delivery piston
5 Thrust pad
6 Front retraining plate



6.129 Excess-fuel delivery carriage in normal delivery position - Lucas DPC pump

1 Spring
2 Spacer
3 Rear retaining plate

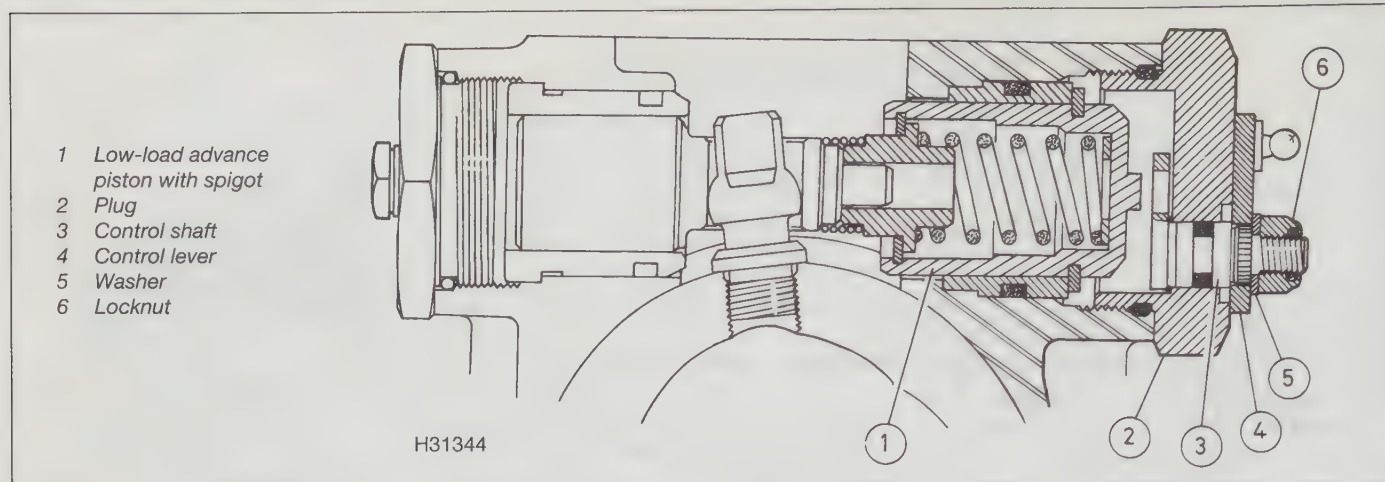
4 Excess-fuel delivery piston
5 Thrust pad
6 Front retraining plate



6.133a Automatic advance override external components - Lucas DPC pump

1 Idling lever

2 Connecting link



6.133b Automatic advance override internal components – Lucas DPC pump

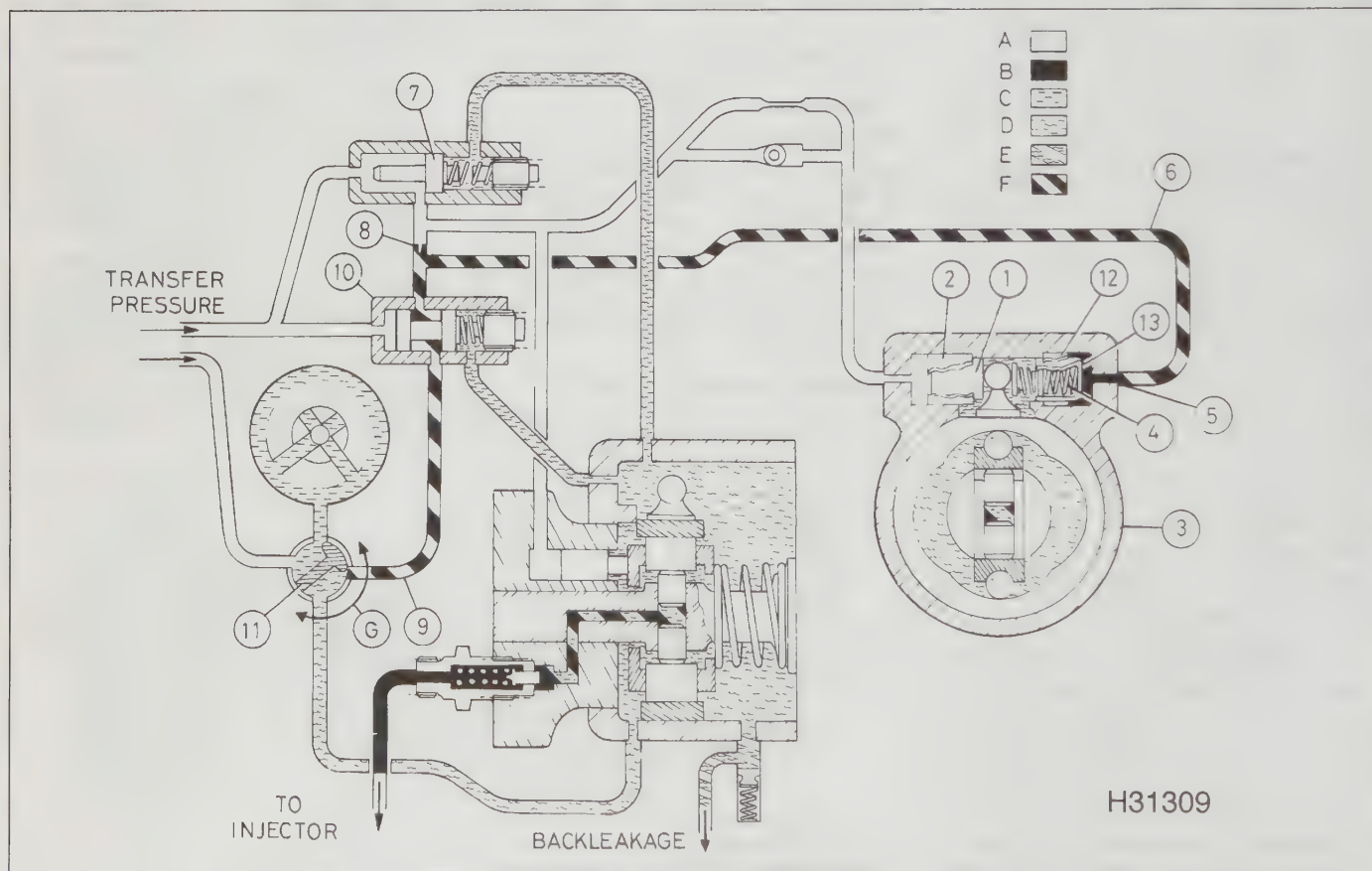
Low-load advance

135 This system advances injection timing at light loads. It works by applying a variable hydraulic pressure, known as *load pressure*,

to a low-load advance piston positioned on the spring (retard) side of the automatic advance piston (**see illustration**).

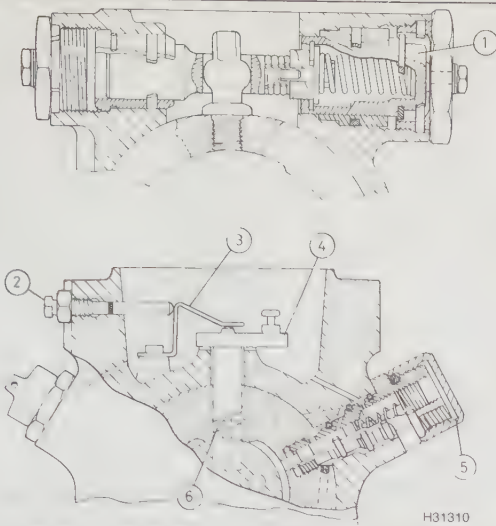
136 Load pressure has a value somewhere

between transfer pressure and residual (cam box) pressure. It is controlled by a low-load advance valve and by a variable orifice. The orifice may be part of the metering valve, or



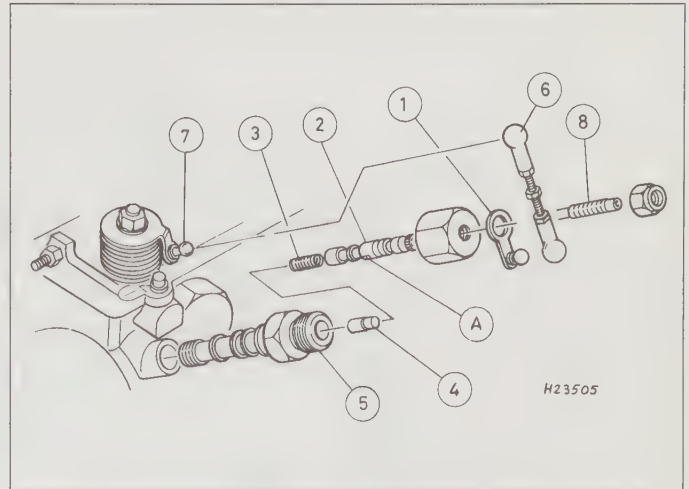
6.135 Load pressure circuit – low-load advance system (Lucas DPC pump)

- | | | | | |
|------------------|------------------------------|---------------------------|----------------------------|-------------------------|
| 1 Advance piston | 5 Low-load advance piston | 8 Calibrated orifice | 12 Low-load advance sleeve | C Metering pressure |
| 2 Sleeve | 6 Load pressure circuit | 9 Duct | 13 Circlip | D Cambox pressure |
| 3 Pump housing | 7 Excess-fuel delivery valve | 10 Low-load advance valve | A Transfer pressure | E Back-leakage pressure |
| 4 Advance spring | 11 Metering valve | B Injection pressure | F Load pressure | G Variable orifice |



6.136a Low-load advance components with orifice on metering valve – Lucas DPC pump

- | | |
|---------------------------|--------------------------|
| 1 Low-load advance piston | 4 Metering valve |
| 2 Adjuster screw | 5 Low-load advance valve |
| 3 Metering valve stop | 6 Variable orifice |



6.136b Low-load advance valve with external connection to control lever – Lucas DPC pump

- | | |
|--------------------------|----------------------------|
| 1 Lever | 6 Link |
| 2 Shaft | 7 Control (throttle) lever |
| 3 Spring | 8 Adjuster screw |
| 4 Cut-off piston | A Variable orifice |
| 5 Low-load advance valve | |

part of the low-load advance valve. In the latter case, the low-load advance valve has an external connection to the control lever (see illustrations).

137 At low speed and load (metering valve opening or control lever movement small), the variable orifice is open, and load pressure is low. Transfer pressure acts on the advance piston unopposed by the low-load advance piston; a large degree of advance takes place.

138 Movement of the metering valve or control lever with increasing load reduces the variable orifice in the load pressure circuit, and causes load pressure to rise. The increased pressure moves the low-load advance piston off its seat and compresses the spring, reducing the degree of advance.

139 On some versions, low-load advance is not applied above a certain speed, as determined by transfer pressure.

Turbo boost controller

140 The function of the turbo boost controller is to increase maximum fuel delivery in proportion to turbo boost pressure.

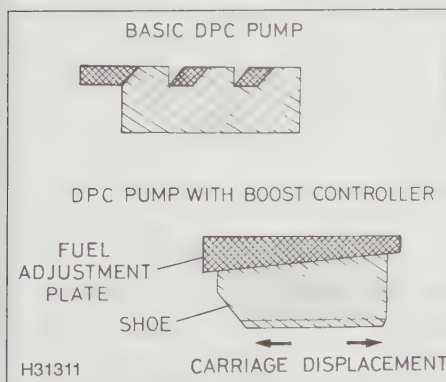
141 Besides the boost controller itself, the system makes use of a modified excess-fuel delivery carriage (see illustration). Instead of the slots and castellations machined in the plunger roller shoes and the maximum-fuel delivery plate, there is an inclined plane. Excess delivery is thus continuously variable, instead of being an 'on/off' function.

142 Increasing boost pressure acts on the

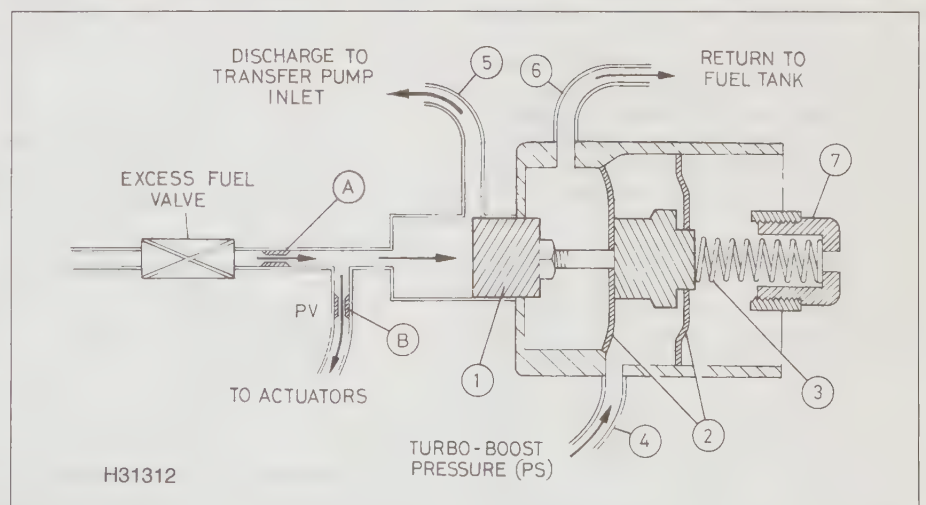
diaphragms in the controller, and moves a piston (see illustration). The piston uncovers a passage in the hydraulic circuit, which leads to the excess-fuel delivery pistons. Pressure in the hydraulic circuit is reduced, and the spring moves the excess-fuel delivery carriage to a position where maximum delivery is increased.

Hydraulic governor (Lucas DPA pump)

143 This governor is of the all-speed type. Its operation depends on the fact that pump transfer pressure varies with pump speed.

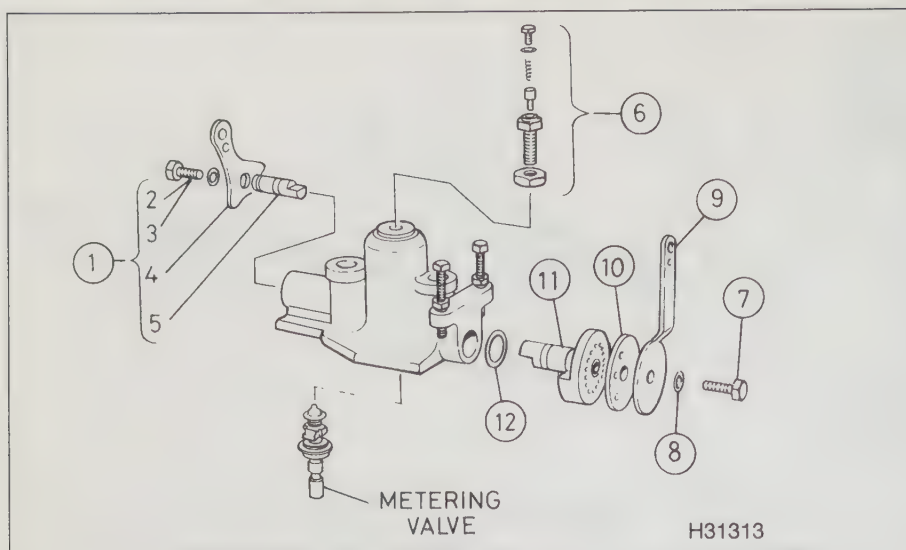


6.141 Modified excess-fuel delivery carriage used with turbo boost controller – Lucas DPC pump



6.142 Action of turbo boost controller with increasing pressure – Lucas DPC pump

- | | | |
|-----------------------------|--------------------------|----------------------|
| 1 Piston | 5 Fuel discharge passage | A Orifice |
| 2 Diaphragms | 6 Fuel return passage | B Orifice |
| 3 Spring | 7 Adjuster | Pv Actuator pressure |
| 4 Boost pressure correction | | |



6.144a Hydraulic governor components – Lucas DPA pump

- | | | |
|-----------------------------|-------------------|----------------------------|
| 1 Shut-off control assembly | 5 Shaft | 9 Control (throttle) lever |
| 2 Screw | 6 Anti-stall stop | 10 Plate |
| 3 Lockwasher | 7 Screw | 11 Control plate and shaft |
| 4 Lever | 8 Lockwasher | 12 O-ring |

144 The opening of the metering valve is determined by the balance between transfer pressure on one side, and spring pressure on the other side. Spring pressure is varied by movement of the pump control (throttle) lever, which is transmitted by means of a shaft with a flat on it and a control sleeve (see illustrations).

Idling

145 The resting position of the control lever is set by the idle speed adjusting screw. The flat on the governor shaft depresses the control sleeve, tending to open the metering valve. Transfer pressure and an idle speed spring work in the opposite direction, tending to close the valve.

146 If engine speed rises, increasing transfer pressure will lift the metering valve. Fuel delivery will be reduced, transfer pressure will fall, and the metering valve will open again. In practice, idle speed will stabilise at the point where the various forces are in balance.

On the road

147 Depression of the accelerator pedal turns the governor shaft and depresses the control sleeve further, against the metering valve spring. The metering valve will open until transfer pressure and spring pressure forces are in balance.

148 If engine load increases, speed will fall. Transfer pressure will reduce, and the metering valve will open further. If load decreases, the reverse will occur.

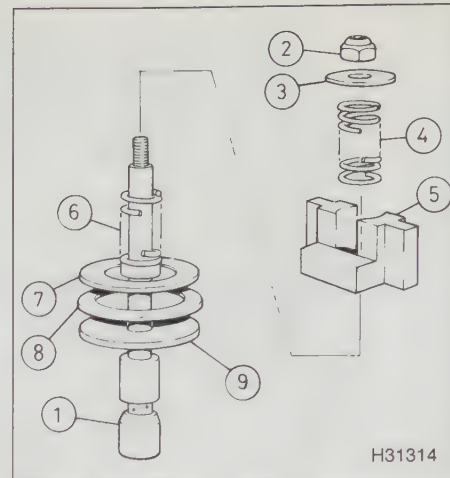
149 At maximum load, the control lever is against its stop, and the downward pressure on the metering valve is at its highest. An increase in engine speed to the governed maximum will lift the metering valve, and reduce or stop fuel delivery.

Anti-stall

150 An adjustable stop in the top of the governor housing limits upward movement of the metering valve during rapid deceleration, keeping fuel delivery high enough to prevent stalling.

Shut-off

151 Mechanical shut-off is achieved using a separate rod and lever. Movement of the lever turns the rod and lifts the control sleeve, closing the delivery valve.

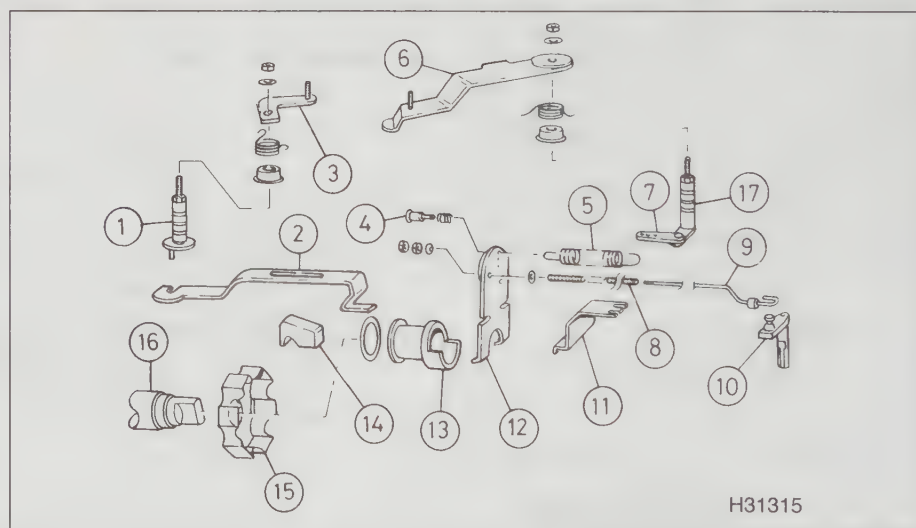


6.144b Metering valve and control sleeve components – Lucas DPA pump hydraulic governor

- | | |
|-------------------|-------------------------|
| 1 Metering valve | 6 Metering valve spring |
| 2 Nut | 7 Damper washer |
| 3 Shut-off washer | 8 Floating washer |
| 4 Idle spring | 9 Sealing washer |
| 5 Control sleeve | |

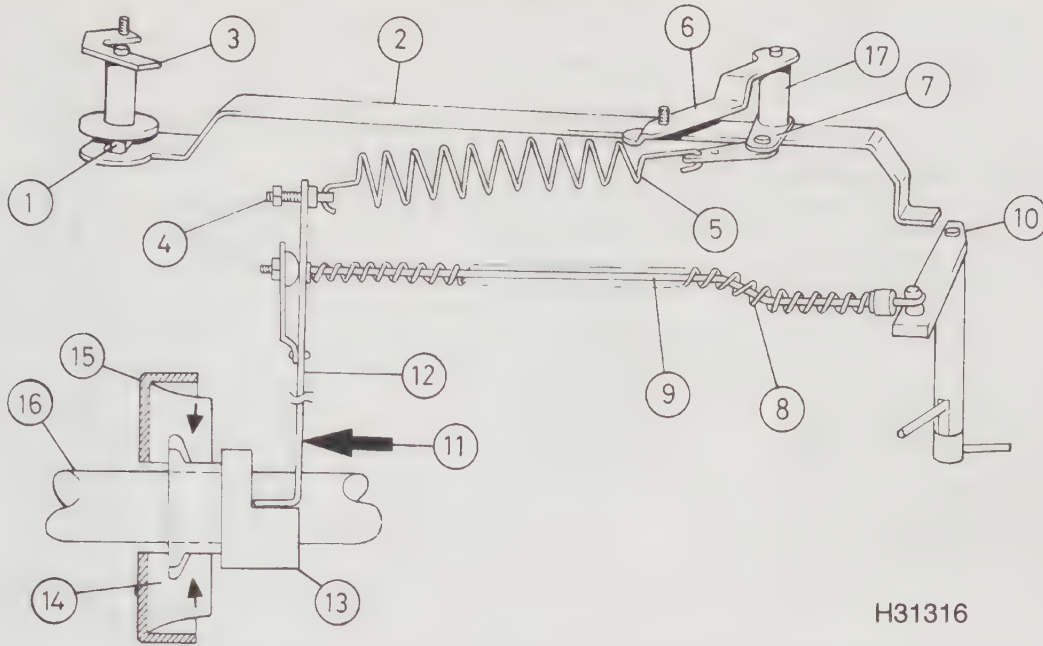
Centrifugal all-speed governor (Lucas DPA and DPC pumps)

152 A set of centrifugal weights is mounted on the pump driveshaft. Movement of the weights is transmitted by an arm and spring link to the fuel metering valve. The force exerted by the weight is opposed by the governor main spring, the tension of which is varied by movement of the control (throttle) lever (see illustration).



6.152 Centrifugal all-speed governor and shut-off mechanisms – Lucas DPC pump

- | | | |
|----------------------------|------------------------|-----------------------|
| 1 Shut-off shaft | 7 Governor spring link | 13 Thrust sleeve |
| 2 Shut-off bar | 8 Linkage hook spring | 14 Centrifugal weight |
| 3 Shut-off lever | 9 Linkage hook | 15 Weight retainer |
| 4 Idle spring guide | 10 Metering valve | 16 Driveshaft |
| 5 Governor main spring | 11 Control bracket | 17 Control shaft |
| 6 Control (throttle) lever | 12 Governor arm | |



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6.155 Centrifugal all-speed governor in full-load/low-speed position – Lucas DPC pump

- | | | | |
|------------------------|----------------------------|--------------------|-----------------------|
| 1 Shut-off shaft | 6 Control (throttle) lever | 10 Metering valve | 14 Centrifugal weight |
| 2 Shut-off bar | 7 Governor spring link | 11 Control bracket | 15 Weight retainer |
| 3 Shut-off lever | 8 Linkage hook spring | 12 Governor arm | 16 Driveshaft |
| 4 Idle spring guide | 9 Linkage hook | 13 Thrust sleeve | 17 Control shaft |
| 5 Governor main spring | | | |

Idling

153 The resting position of the control lever is set by the idle speed adjusting screw. The control lever pulls on the governor arm in the direction of increased fuel delivery; outward movement of the centrifugal weights with

increasing speed creates a force in the opposite direction.

154 For greater sensitivity in the idle speed range, the governor main spring is attached to the governor arm by a pin and an idle speed spring. It is the idle speed spring which determines the balance of forces.

On the road

155 When the accelerator pedal is depressed, the control lever is moved to increase governor spring tension (**see illustration**). The governor arm moves to open the metering valve, so increasing the quantity of fuel delivered. The idle speed spring is compressed, and has no more effect.

156 As engine speed rises, the force exerted by the weights begins to overcome the spring tension. The governor arm moves to close the metering valve, reducing fuel delivery.

157 At maximum governed speed, the force of the weights is sufficient to close the metering valve completely (**see illustration**).

Anti-stall

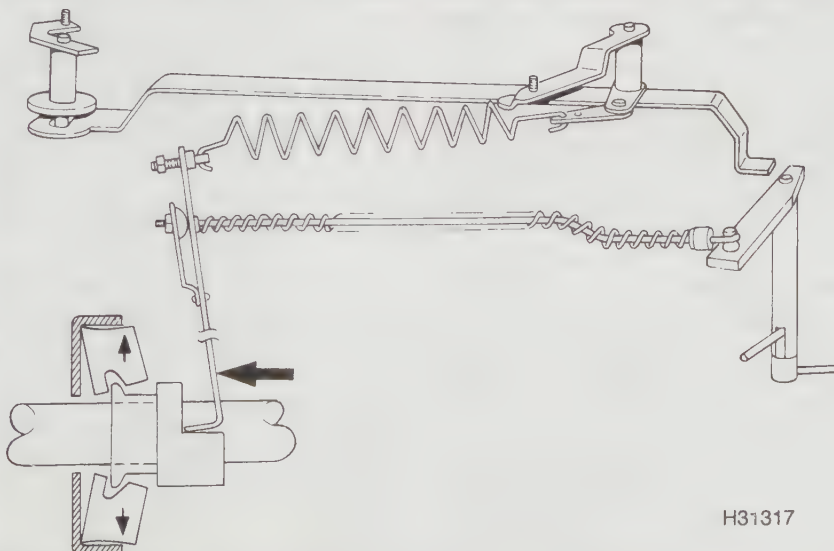
158 An anti-stall adjustment screw limits the movement of the governor arm during rapid deceleration, keeping fuel delivery high enough to prevent stalling.

Shut-off

159 Mechanical shut-off is achieved by a separate lever, which when operated compresses the governor spring link and closes the metering valve.

Centrifugal two-speed governor (Lucas DPC and DPS pumps)

160 This governor is similar to the all-speed mechanical governor described previously,



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6.157 Centrifugal all-speed governor in maximum-speed position

2•42 Fuel injection systems

but it is only effective at idle and maximum speeds; at intermediate speeds, control lever movement is transmitted directly to the metering valve (**see illustration**). This gives an accelerator response similar to that obtained from petrol engines.

Idling

161 At idle, the balance of forces is between the governor weights and the idle leaf spring. The tension of this spring is determined by the position of the idle actuator, attached to the idle lever shaft. In this way, idle speed adjustment is independent of control lever resting position.

On the road

162 At intermediate speeds, the governor has no effect. The main governor spring acts as a rigid link between the control lever and the metering valve.

163 As maximum speed is approached, the force of the governor weights overcomes that of the main spring, and the metering valve is moved in the direction of reduced fuel delivery.

Anti-stall

164 An anti-stall device between the governor arm and the end of the governor spring limits governor arm movement during sudden deceleration, keeping fuel delivery high enough to prevent stalling. Adjustment of the anti-stall function is effectively determined by the control lever resting position.

Shut-off

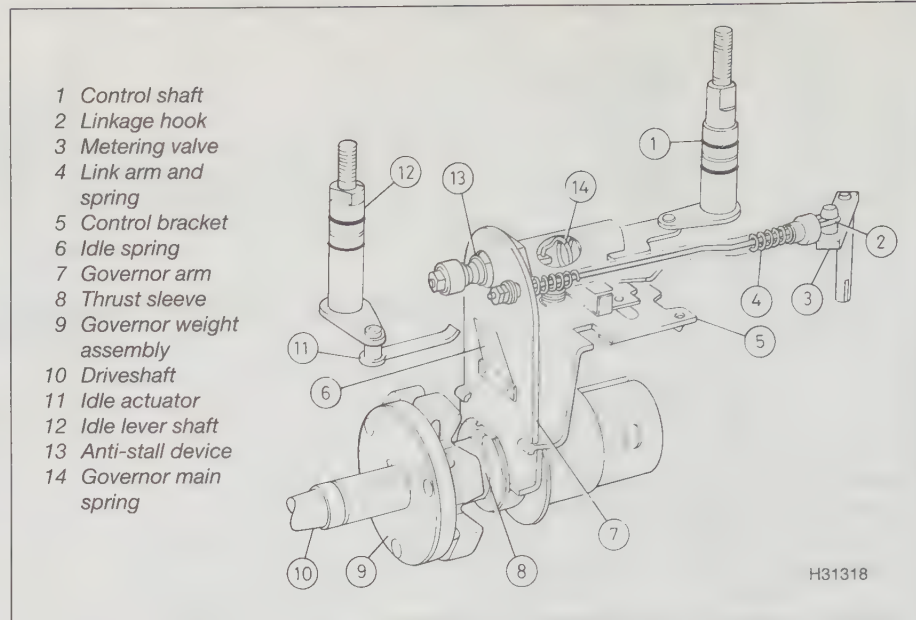
165 When fitted, manual shut-off may be controlled by a separate lever on the idling lever shaft, or by a 'stop' position of the existing idling lever.

7 Injectors

Note: The information given in this Section refers to conventional diesel fuel injectors. For details of the injectors used in common rail and 'pump injector' systems, refer to Sections 9 and 10 respectively.

1 One fuel injector is fitted to each cylinder. The function of the injector is to spray an evenly-atomised quantity of fuel into the combustion or pre-combustion chamber when the fuel pressure exceeds a certain value, and to stop the flow of fuel cleanly when the pressure drops. It must make a gas-tight seal where it enters the cylinder head, and a pressure-tight seal where the fuel injector pipe is connected to it. It must also have a fuel return connection, where fuel which leaks past the injector needle can be collected for return to the tank.

2 Atomisation is achieved by a spring-loaded needle, which vibrates rapidly against its seat when fuel under pressure passes it. The



6.160 Lucas DPS pump two-speed governor

needle and seat assembly together are known as the injector nozzle. They are finely matched in production, and may only be renewed together.

3 The pressure at which the nozzle opens is determined by the spring pressure. This is adjustable, usually by shim thickness, but sometimes by means of an adjusting screw.

4 The direction, penetration and quality of fuel spray are all important features of injector design. Each type of engine and combustion chamber has particular requirements which its injectors are designed to meet. Injectors are not necessarily interchangeable between engines, even though their external dimensions and appearance may be identical.

5 There are two basic types of injector; hole (orifice) and pintle. Hole types are usually fitted to direct injection engines, and pintle types to indirect injection units.

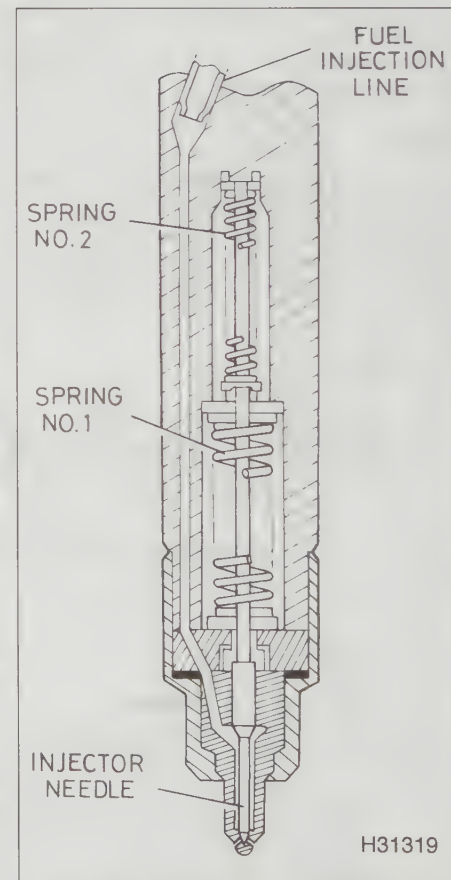
6 Injectors may be screwed directly into the cylinder head, or they may be secured by a clamp or flange. Clamp fitting enables the fitted position of the injector to be controlled, for example to ensure that an asymmetrical hole pattern is correctly positioned with regard to the combustion chamber.

Hole injectors

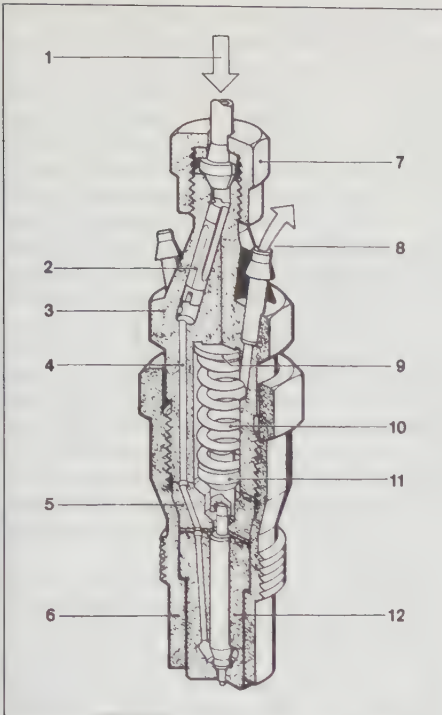
7 The nozzle seat and the injector tip are conical. The atomised fuel is discharged into a so-called blind hole, which is in fact opened by one or more injection holes. Multi-hole arrangements are common.

8 A single-hole injector may have the hole positioned either centrally or offset. The holes in a multi-hole injector are not necessarily arranged symmetrically, nor need they all be the same size. The Pintaux type nozzle has two holes; a main one, centrally positioned, and an auxiliary one offset to one side.

9 A two-stage hole injector is used in certain Rover and VW engines. Each injector contains two springs. (**see illustration**) The weaker spring allows a small 'pre-injection' spray to



7.9 Sectional view of a two-stage hole injector



7.12a Cutaway view of a pintle injector

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- | | |
|--------------------|---------------------------|
| 1 Fuel inlet | 7 Union nut |
| 2 Integral filter | 8 Fuel return |
| 3 Body | 9 Pressure adjusting shim |
| 4 Pressure passage | 10 Spring |
| 5 Sleeve | 11 Spindle |
| 6 Nozzle retainer | 12 Nozzle |

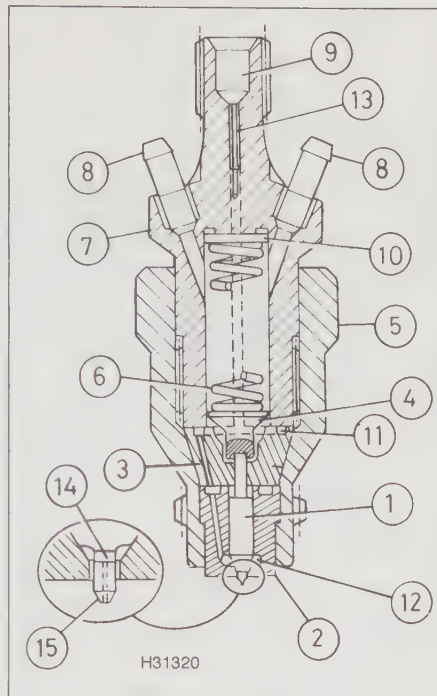
occur before the main injection; as with pintle injectors, this gives a softer and quieter combustion.

10 The nozzle holes on a brand-new injector are slightly larger than they ultimately need to be. This is to allow for the carbon coating which will inevitably accumulate in service. While the holes are still too large, combustion may be harsher and noisier. This should be borne in mind when judging the noise produced by a new engine, or after fitting new injectors.

11 Opening pressures for hole type injectors are typically between 150 and 250 bar.

Pintle injectors

12 Throttling pintle injectors as they are properly known, have a nozzle seat shaped to match the pintle on the tip of the nozzle needle. The seat and pintle are shaped so that initial opening produces a small 'pre-injection' spray, which builds up relatively gradually into the main injection spray. Spray pattern and penetration will be determined by the shape of the needle and seat, and by spring rate. Sometimes the needle tip has longitudinal and transverse bores (*perforated pintle*) (see illustrations).



7.12b Sectional view of a perforated pintle injector

- | | |
|-------------------|----------------------------|
| 1 Nozzle needle | 9 Fuel inlet |
| 2 Nozzle body | 10 Pressure-adjusting shim |
| 3 Sleeve | 11 Ring groove |
| 4 Spindle | 12 Pressure chamber |
| 5 Nozzle retainer | 13 Integral filter |
| 6 Spring | 14 Transverse bore |
| 7 Body | 15 Longitudinal bore |
| 8 Fuel return | |

13 The progressive injection characteristics of this type of injector, in conjunction with swirl or pre-combustion chamber design, gives smooth combustion.

14 Opening pressures for pintle-type injectors are typically between 110 and 140 bar.

8 Electronic diesel engine control systems

Description

1 In recent years, the development of the automotive diesel engine has become governed by the requirement for low exhaust emissions, and improved fuel economy, performance and driveability. These requirements place increasingly heavy demands on the fuel injection system due to the need for improved accuracy and sensitivity of fuel delivery and injection timing controls.

2 In the diesel engine, combustion, and therefore the operating characteristics are influenced by:

- The quantity of fuel injected.*
- The start-of-injection point.*
- Exhaust gas recirculation.*
- Intake (charge) air pressure.*

To ensure maximum efficiency, these variables must be adjusted to the optimum values for the prevailing operating conditions. The use of an electronic control system allows this, and also provides improved reliability compared to a mechanically-controlled system.

3 An electronic diesel control system uses various sensors (many similar to those used on a petrol injection system), an electronic control unit, and various actuators. The information from the various sensors is passed to an electronic control unit (ECU), which evaluates the signals. The ECU contains electronic 'maps' which enable it to calculate the optimum quantity of fuel to inject, and the appropriate injection timing, for any given condition of engine operation. The maps can take into account particular requirements to optimise factors such as noise, smoke emission, fuel consumption or power output. In order to perform the necessary calculations, the ECU receives signals from sensors or transducers providing the following information (not all sensors will be found on all systems):

- Crankshaft speed and position.*
- Accelerator pedal position.*
- Gear lever or selector position.*
- Injection start point.*
- Pump control rod/spool position.*
- Intake airflow.*
- Road speed.*
- Air temperature.*
- Coolant temperature.*
- Fuel temperature.*
- Atmospheric pressure.*
- Inlet manifold pressure.*
- Brake/clutch switches.*

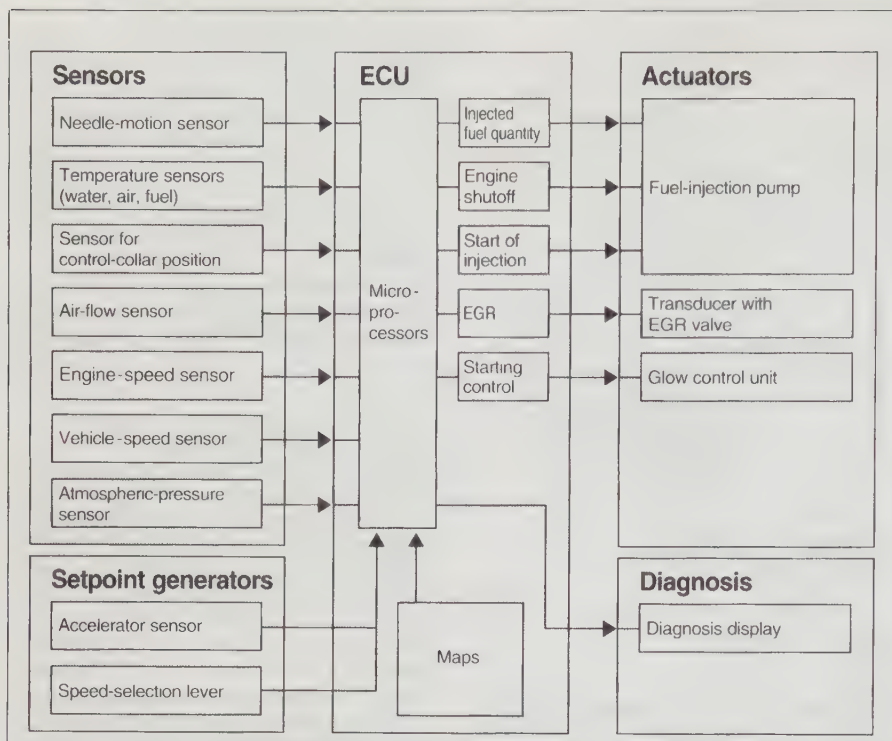
4 Besides controlling injection pump delivery and injection timing, the ECU can also be used to control the preheating system, exhaust gas recirculation and, where applicable, a cruise control system (see illustration overleaf). 'Limp-home' and emergency functions enable the system to keep functioning (albeit at reduced efficiency) if a sensor fails. A self-diagnosis function illuminates an instrument panel warning light in case of failure; using appropriate test equipment, the ECU can be interrogated to locate the problem rapidly.

Injection pumps

5 Electronic diesel control systems are used on both in-line and distributor injection pumps, and the fine degree of control available has also allowed the development of common rail and 'pump-injector' systems, both of which are described in more detail in Sections 9 and 10 of this Chapter.

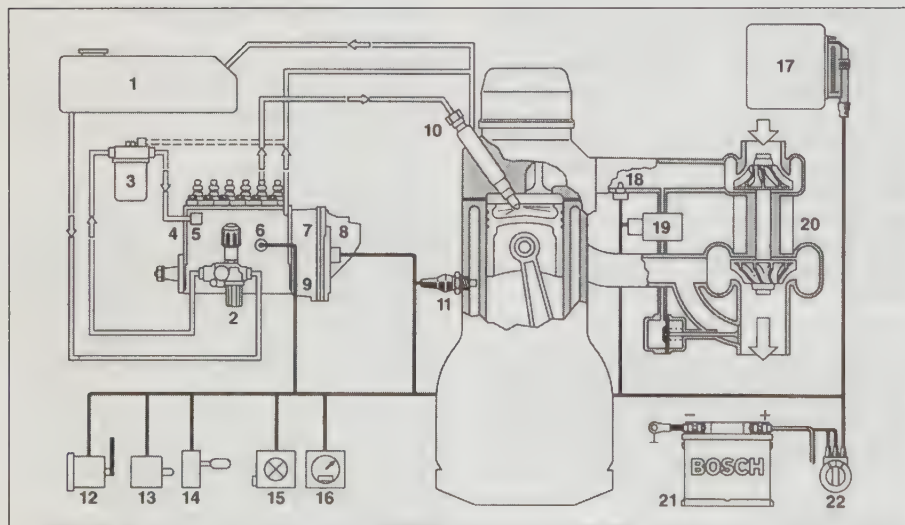
In-line injection pumps

6 In an electronically-controlled in-line



8.4 Bosch electronic diesel control system block diagram

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8.7 Bosch electronic diesel control system with in-line injection pump

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- | | | |
|-------------------------------|---|---------------------------------|
| 1 Fuel tank | 10 Injector | 16 Vehicle speed sensor |
| 2 Lift pump | 11 Coolant temperature sensor | 17 Electronic control unit |
| 3 Fuel filter | 12 Accelerator pedal position sensor | 18 Air temperature sensor |
| 4 In-line injection pump | 13 Brake and clutch switches | 19 Charge-air pressure sensor |
| 5 Electrical shut-off device | 14 Cruise control switch | 20 Turbocharger |
| 6 Fuel temperature sensor | 15 Warning lamp and diagnostic connection | 21 Battery |
| 7 Control rod position sensor | | 22 Glow plug and starter switch |
| 8 Linear solenoid | | |
| 9 Pump speed sensor | | |

injection pump, a control solenoid is fitted in place of the mechanical governor. The linear solenoid moves the pump control rod in response to signals from the ECU. The injected fuel quantity is a function of the control rod position and pump speed. The control solenoid is connected directly to the pump, and its linear movement moves the pump control rod according to the operating current supplied by the ECU. When the solenoid is de-energised, a spring forces the control rod to the 'stop' position and prevents the delivery of fuel to the engine. When the solenoid is energised, it exerts a force on the control rod which opposes the spring force; this force increases as the current in the solenoid rises, and moves the control rod in the 'increased-delivery' direction. This enables continual adjustment of the fuel quantity between zero and maximum, according to the current supplied to the solenoid.

7 A control rod position sensor and a pump speed sensor are incorporated into the pump to supply appropriate information to the ECU. The ECU selects the appropriate map for injected fuel quantity and injection timing according to the information received from the various system sensors (see illustration).

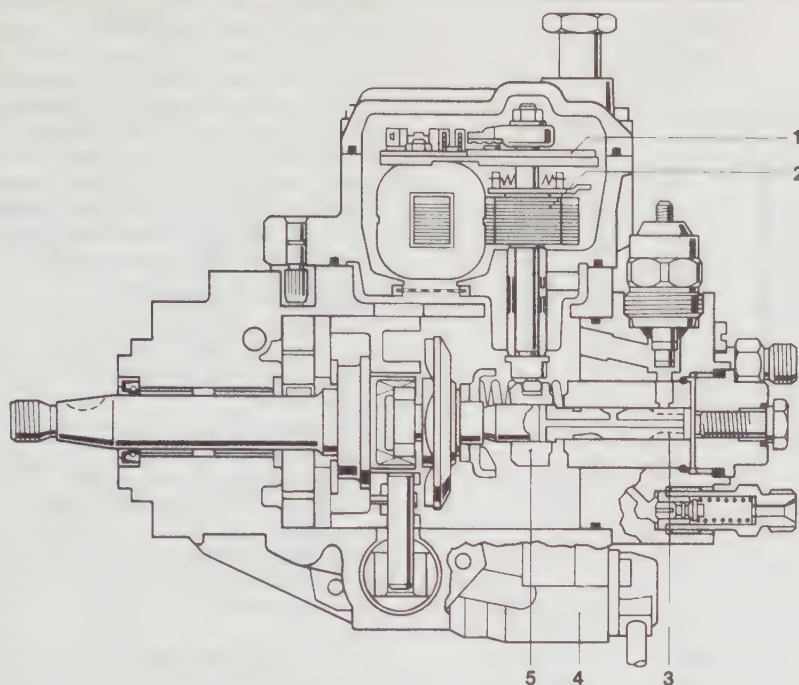
Distributor injection pumps

8 One of the commonest electronically-controlled distributor injection pumps likely to be encountered is based on the Bosch VE pump (see illustration). Although there are other types of electronically-controlled pump in use (eg, Lucas DP series), we will use the Bosch type as a typical example to explain the principles involved.

9 Compared with the earlier VE pumps, the electronically-controlled pump is considerably simplified. The mechanical governor and many of the add-on pump units previously used are discarded in favour of a single electronic actuator, which moves the control spool in response to signals from an electronic control unit (ECU). The actuator also moves a potentiometer which is used by the ECU to monitor the control spool position. For safety reasons, the actuator is spring-loaded so that if there is no current across its terminals, the control spool is moved into the 'stop' or zero-delivery position.

10 Internally, the injection pump resembles earlier VE pumps, as far as the supply pump and high-pressure pump are concerned. Pump cavity pressure is still used to determine injection advance, but the pressure is modulated by a solenoid valve, which is opened and closed in a rapid cycle by the ECU. The ratio of open- to closed-time determines cavity pressure, which is highest when the valve is closed.

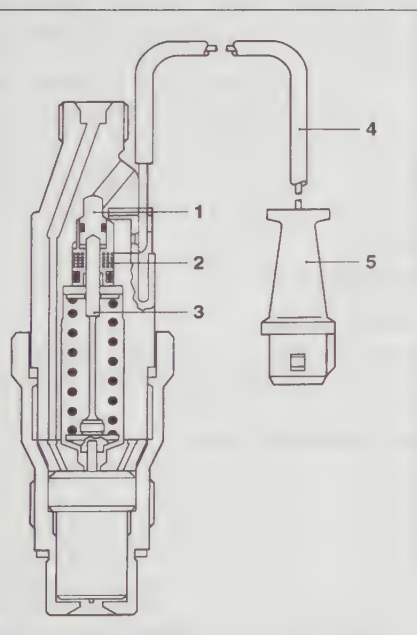
11 A stop solenoid is still fitted to interrupt the fuel supply to the high-pressure pump, but this is a safety measure, since normally the



8.8 Bosch VE injection pump with electronic diesel control

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- | | | |
|---------------------------------|-----------------------|------------------------------------|
| 1 Control spool position sensor | 2 Electrical actuator | 4 Cavity pressure control solenoid |
| 3 Pump plunger | 5 Control spool | |



8.12 Fuel injector with needle motion sensor for electronic diesel control

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- | | |
|------------------|---------|
| 1 Adjusting pin | 4 Cable |
| 2 Sensor winding | 5 Plug |
| 3 Pressure pin | |

systems are described in greater detail in the following sections.

15 In the future it is likely that the use of these high-pressure systems will become more widespread, and other similar systems will be developed, as the narrowing gap between diesel and petrol engine refinement is closed still further.

9 Common rail systems

Description

1 The most widespread common rail system in current use is the Bosch system. Although there are other types of common rail system (eg, Caterpillar system), we will use the Bosch type as a typical example to explain the principles involved.

2 The common rail system derives its name from the fact that a common rail, or fuel reservoir, is used to supply fuel to all the fuel injectors. Instead of an in-line or distributor fuel pump, which distributes the fuel directly to each injector, a high-pressure pump is used, which generates a very high fuel pressure (up to 1350 bar on some systems) in the accumulator rail. The accumulator rail stores fuel, and maintains a constant fuel pressure, with the aid of a pressure control valve. Each injector is supplied with high-pressure fuel from the accumulator rail, and the injectors are individually controlled via signals from the system electronic control unit. The injectors are electromagnetically-operated.

3 In addition to the various sensors used on models with a conventional fuel injection pump, common rail systems also have a fuel pressure sensor. The fuel pressure sensor allows the electronic control unit to maintain the required fuel pressure, via the pressure control valve.

electrical actuator will stop fuel delivery when the 'ignition' is switched off.

12 Most of the sensors used in the system will be recognised as being similar to those used in petrol injection systems, but the injection start-point sensor is unique to the distributor pump-equipped diesel engine. The sensor is incorporated into one of the injectors, and senses the movement of the injector needle (see illustration).

Future developments

13 Recent developments in electronic diesel control systems and the introduction of 'common rail' and 'pump injector' fuel systems have closed the performance and refinement gap between diesel and petrol engines. In spite of this, there is still a need to improve the performance, driveability and emissions standards of diesel engines.

14 The current trend in diesel engine technology is to develop direct injection engines, using high injection pressures. Higher injection pressures enable finer control of the start and end of injection points, and improved fuel atomisation, both of which improve engine efficiency and refinement. This trend has led to the development of common rail and 'pump injector' systems, which dispense with the need for high-pressure fuel lines to connect a pump to the injectors. Common rail and 'pump injector'

Operation

4 For the purposes of describing the operation of a common rail injection system, the components can be divided into three sub-systems; the low-pressure fuel system, the high-pressure fuel system and the electronic control system.

Low-pressure fuel system

5 The low-pressure fuel system consists of the following components:

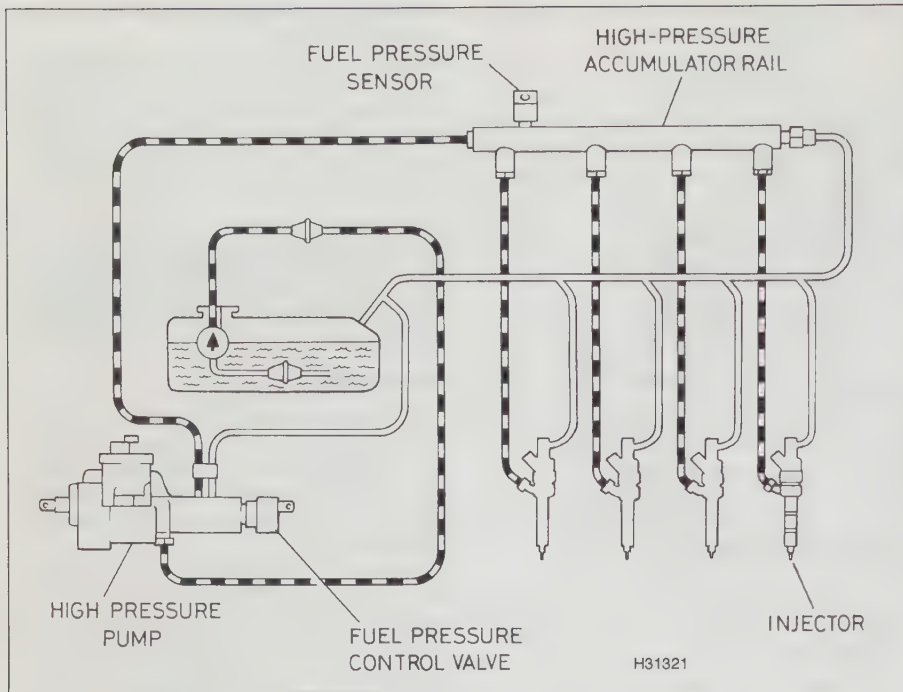
Fuel tank.

Fuel lift pump.

Fuel filter/water trap.

Low-pressure fuel lines.

6 The low-pressure system (fuel supply system) is responsible for supplying clean fuel to the high-pressure fuel circuit. Refer to Section 3 of this Chapter for further details of the fuel supply components.



9.7 Schematic view of high-pressure fuel system – Bosch common rail system

High-pressure fuel system

7 The high-pressure fuel system consists of the following components (see illustration):

- High-pressure fuel pump with pressure control valve.
- High-pressure accumulator rail with fuel pressure regulator.
- Fuel injectors.
- High-pressure fuel lines.

8 After passing through the fuel filter, the fuel reaches the high-pressure pump, which forces it into the accumulator rail, generating pressures of up to 1350 bar. As diesel fuel has

a certain elasticity, the pressure in the accumulator rail remains constant, even though fuel leaves the rail each time one of the injectors operates: additionally, a pressure control valve mounted on the high-pressure pump ensures that the fuel pressure is maintained within pre-set limits.

9 The pressure control valve is operated by the ECU. When the valve is opened, fuel is returned from the high-pressure pump to the tank, via the fuel return lines, and the pressure in the accumulator rail falls. To enable the ECU to trigger the pressure control valve correctly, the pressure in the accumulator rail is measured by a fuel pressure sensor.

10 The electromagnetically-controlled fuel injectors are operated individually, via signals from the ECU, and each injector injects fuel directly into the relevant combustion chamber. The fact that high fuel pressure is always available allows very precise and highly flexible injection in comparison to a conventional injection pump: for example combustion during the main injection process can be improved considerably by the pre-injection of a very small quantity of fuel.

Electronic control system

11 The electronic control system consists typically of the following components:

- Electronic control unit (ECU).
- Fuel lift pump.
- Crankshaft speed/position sensor.
- Camshaft position sensor.
- Accelerator pedal position sensor.
- Turbocharger boost pressure sensor.
- Air temperature sensor.
- Coolant temperature sensor.
- Air mass meter.
- Fuel pressure sensor.
- Fuel injectors.
- Fuel pressure control valve.
- Preheating control circuit.
- EGR valve actuator.

12 As mentioned in Section 8, the information from the various sensors is passed to the ECU, which evaluates the signals. The ECU contains electronic 'maps' which enable it to calculate the optimum quantity of fuel to inject, the appropriate start of injection, and even pre- and post injection fuel quantities, for each individual engine cylinder under any given condition of engine operation.

13 Additionally, the ECU carries out monitoring and self-diagnostic functions. Any faults in the system are stored in the ECU memory, which enables quick and accurate fault diagnosis using appropriate diagnostic equipment (such as a suitable fault code reader).

Components

Fuel lift pump

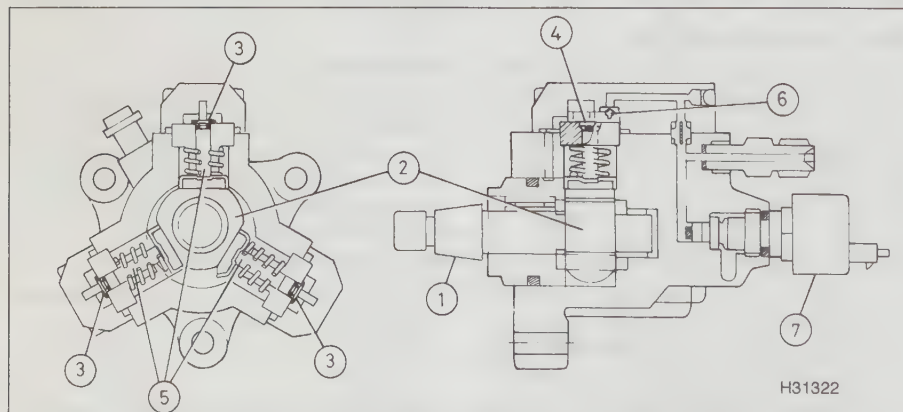
14 The fuel lift pump is usually electrically-operated, and is normally mounted in or near the fuel tank.

High-pressure pump

15 The high-pressure pump is most often mounted on the engine in the position normally occupied by a conventional distributor fuel injection pump. The pump is driven at half engine speed by the engine timing belt, timing chain, or possibly by gears, depending on application. The pump is lubricated by the fuel which it pumps.

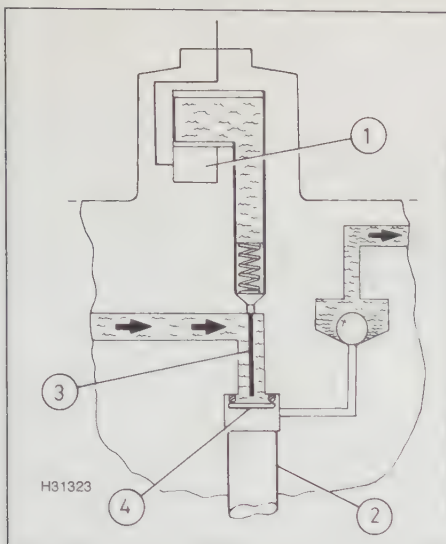
16 The fuel lift pump forces the fuel into the high-pressure pump chamber, via a safety valve.

17 The high-pressure pump consists of a number of radially-mounted pistons and cylinders (see illustration). The pistons are



9.17 Cutaway view of high pressure pump – Bosch common rail system

- | | | |
|---------------------|---------------|--------------------------|
| 1 Driveshaft | 4 Inlet valve | 6 Outlet valve |
| 2 Eccentric cam | 5 Pistons | 7 Pressure control valve |
| 3 Pumping cylinders | | |



9.19 Cutaway view of high pressure pump cylinder 'switch-off' mechanism - Bosch common rail system

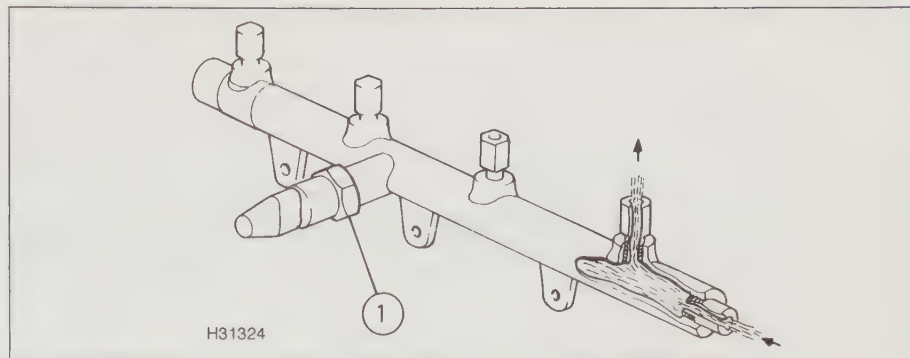
- | | |
|--------------------|---------------|
| 1 Electromagnet | 3 Needle |
| 2 Pumping cylinder | 4 Inlet valve |

operated by an eccentric cam mounted on the pump drive spindle. As a piston moves down, fuel enters the cylinder through an inlet valve. When the piston reaches bottom-dead-centre (BDC), the inlet valve closes, and as the piston moves back up the cylinder, the fuel is compressed. When the pressure in the cylinder reaches the pressure in the accumulator rail, an outlet valve opens, and fuel is forced into the accumulator rail. When

the piston reaches top-dead-centre (TDC), the outlet valve closes, due to the pressure drop, and the pumping cycle is repeated. The use of multiple cylinders (usually three) provides a steady flow of fuel, minimising pulses and pressure fluctuations.

18 As the pump needs to be able to supply sufficient fuel under full-load conditions, it will supply excess fuel during idle and part-load conditions. This excess fuel is returned from the high-pressure circuit to the low-pressure circuit (to the tank) via the pressure control valve.

19 The pump incorporates a facility to effectively switch off one of the cylinders to improve efficiency and reduce fuel consumption when maximum pumping capacity is not required (**see illustration**). When this facility is operated, a solenoid-operated needle holds the inlet valve in the relevant cylinder open during the delivery



9.20 Accumulator rail - Bosch common rail system

- 1 Fuel pressure sensor

stroke, preventing the fuel from being compressed.

Accumulator rail

20 As its name suggests, the accumulator rail acts as an accumulator, storing fuel and preventing pressure fluctuations (**see illustration**). Fuel enters the rail from the high-pressure pump, and each injector has its own connection to the rail. The fuel pressure sensor is mounted in the rail, and the rail also has a connection to the fuel pressure control valve on the pump.

Pressure control valve

21 The pressure control valve is operated by the ECU, and controls the system pressure. The valve may be mounted either on the high-pressure pump, or on the accumulator rail.

22 If the fuel pressure is excessive, the valve opens, and fuel flows back to the tank. If the pressure is too low, the valve closes, enabling the high-pressure pump to increase the pressure.

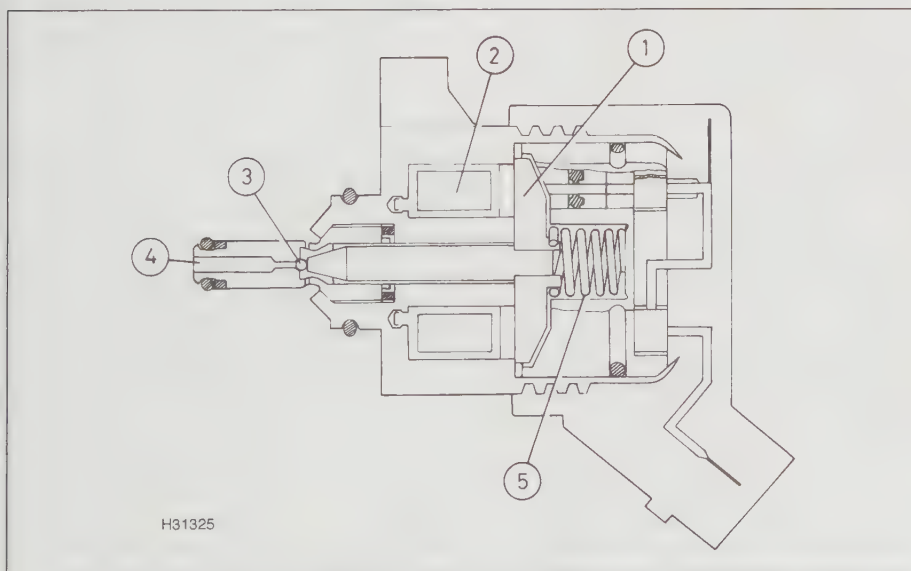
23 The valve is an electromagnetically-operated ball valve (**see illustration**). The ball is forced against its seat, against the fuel pressure, by a powerful spring, and also by the force provided by the electromagnet. The force generated by the electromagnet is directly proportional to the current applied to it by the ECU. The desired pressure can therefore be set by varying the current applied to the electromagnet. Any pressure fluctuations are damped by the spring.

Fuel pressure sensor

24 The fuel pressure sensor is mounted in the accumulator rail, and provides very precise information on the fuel pressure to the ECU.

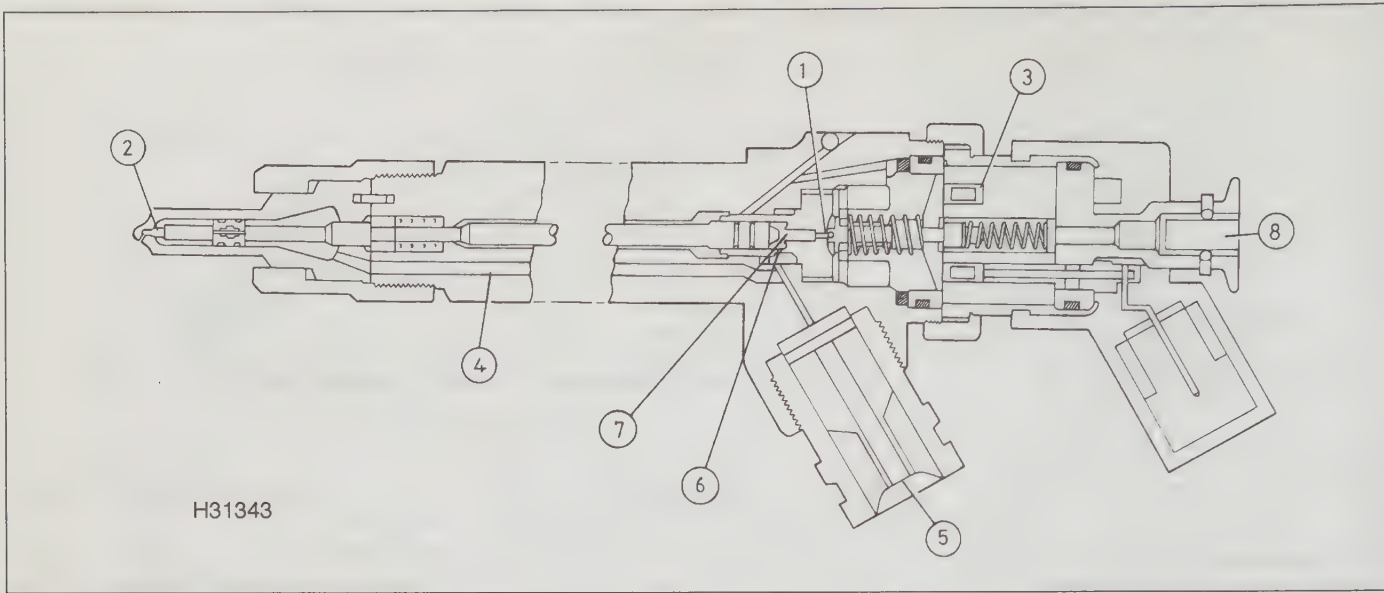
Injector

25 The injectors are mounted on the engine in a similar manner to conventional diesel fuel injectors. The injectors are electromagnetically-operated via signals from the ECU, and fuel is injected at the pressure existing in the accumulator rail. The injectors are high-precision instruments and are manufactured to very high tolerances.



9.23 Cutaway view of pressure control valve - Bosch common rail system

- | | | |
|-----------------|-----------------------|----------|
| 1 Armature | 3 Ball valve | 5 Spring |
| 2 Electromagnet | 4 High pressure inlet | |



9.26 Cutaway view of injector – Bosch common rail system

- | | | | |
|----------|-----------------|-----------------------|-------------------------|
| 1 Valve | 3 Electromagnet | 5 High-pressure inlet | 7 Valve control chamber |
| 2 Nozzle | 4 Injector body | 6 Input throttle | 8 Fuel return |

26 Fuel flows into the injector from the accumulator rail, via an inlet valve and an inlet throttle, and an electromagnet causes the injector nozzle to lift from its seat, allowing injection (**see illustration**). Excess fuel is returned from the injectors to the tank via a return line. The injector operates on a hydraulic servo principle: the forces resulting inside the injector due to the fuel pressure

effectively amplify the effects of the electromagnet, which does not provide sufficient force to open the injector nozzle directly. The injector functions as follows.

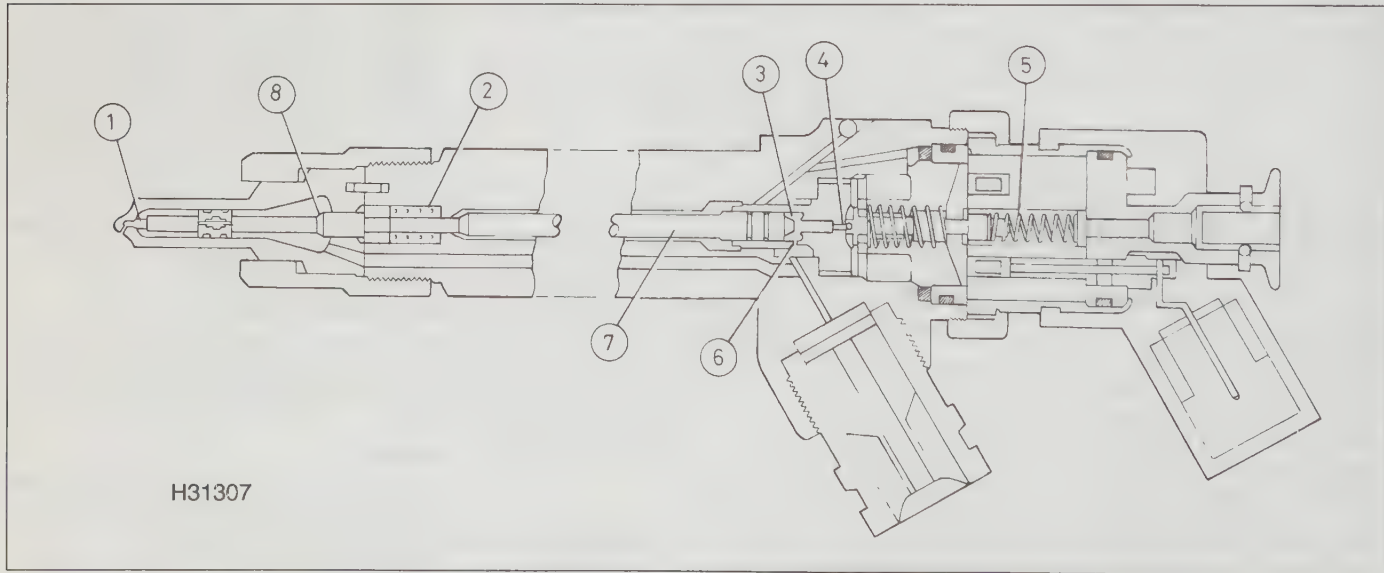
27 Five separate forces are essential to the operation of the injector (**see illustration**).

a) A nozzle spring forces the nozzle needle against the nozzle seat at the bottom of the injector, preventing fuel from entering

the combustion chamber.

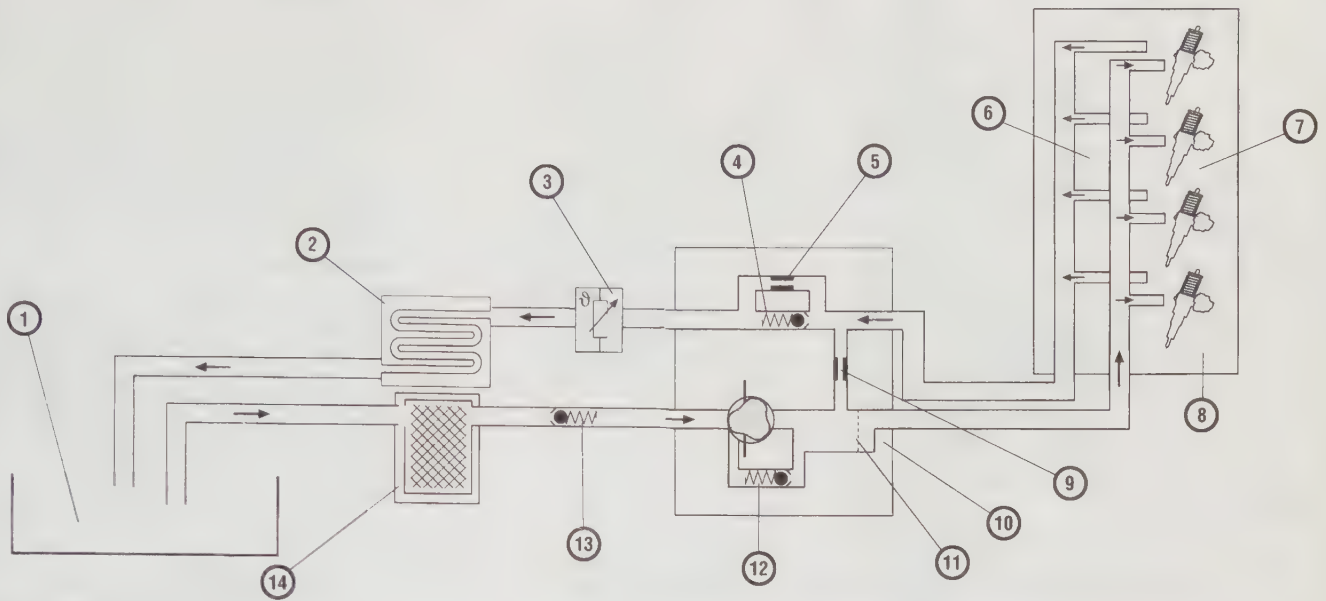
b) In the valve at the top of the injector, the valve spring forces the valve ball against the opening to the valve control chamber. The fuel in the chamber is unable to escape through the fuel return.

c) When triggered, the electromagnet exerts a force which overcomes the valve spring force, and moves the valve ball away from



9.27 Injector components – Bosch common rail system

- | | | | |
|-----------------|-------------------------|------------------|-------------------------|
| 1 Nozzle seat | 3 Valve control chamber | 5 Valve spring | 7 Valve control plunger |
| 2 Nozzle spring | 4 Valve ball | 6 Input throttle | 8 Nozzle needle chamfer |



10.1 Schematic view of Bosch/VW pump injector system

- | | | | |
|---------------------------|-------------------------|--------------|----------------------------|
| 1 Fuel tank | 5 Bypass | 9 Restrictor | 12 Pressure limiting valve |
| 2 Fuel cooler | 6 Fuel distributor pipe | 10 Fuel pump | 13 Non-return valve |
| 3 Fuel temperature sensor | 7 Pump injectors | 11 Strainer | 14 Fuel filter |
| 4 Pressure limiting valve | 8 Cylinder head | | |

its seat. This is the triggering force for the start of injection. When the valve ball moves off its seat, fuel enters the valve control chamber.

- d) The pressure of the fuel in the valve control chamber exerts a force on the valve control plunger, which is added to the nozzle spring force.
- e) A slight chamfer towards the lower end of the nozzle needle causes the fuel in the control chamber to exert a force on the nozzle needle.
- 28 When these forces are in equilibrium, the injector is in its rest (idle) state, but when a voltage is applied to the electromagnet, the forces work to lift the nozzle needle, injecting fuel into the combustion chamber. There are four phases of injector operation as follows:
- Rest (idle) state** – all forces are in equilibrium. The nozzle needle closes off the nozzle opening, and the valve spring forces the valve ball against its seat.
 - Opening** – the electromagnet is triggered which opens the nozzle and triggers the injection process. The force from the electromagnet allows the valve ball to leave its seat. The fuel from the valve control chamber flows back to the tank via the fuel return line. When the valve opens, the pressure in the valve control

chamber drops, and the force on the valve plunger is reduced. However, due to the effect of the input throttle, the pressure on the nozzle needle remains unchanged. The resulting force in the valve control chamber is sufficient to lift the nozzle from its seat, and the injection process begins.

- Injection** – within a few milliseconds, the triggering current in the electromagnet is reduced to a lower holding current. The nozzle is now fully open, and fuel is injected into the combustion chamber at the pressure present in the accumulator rail.
- Closing** – the electromagnet is switched off, at which point the valve spring forces the valve ball firmly against its seat, and in the valve control chamber, the pressure is the same as that at the nozzle needle. The force at the valve plunger increases, and the nozzle needle closes the nozzle opening. The forces are now in equilibrium once more, and the injector is once more in the idle state, awaiting the next injection sequence.

ECU and sensors

- 29 The ECU and sensors are described earlier in this Section – see *Description*.

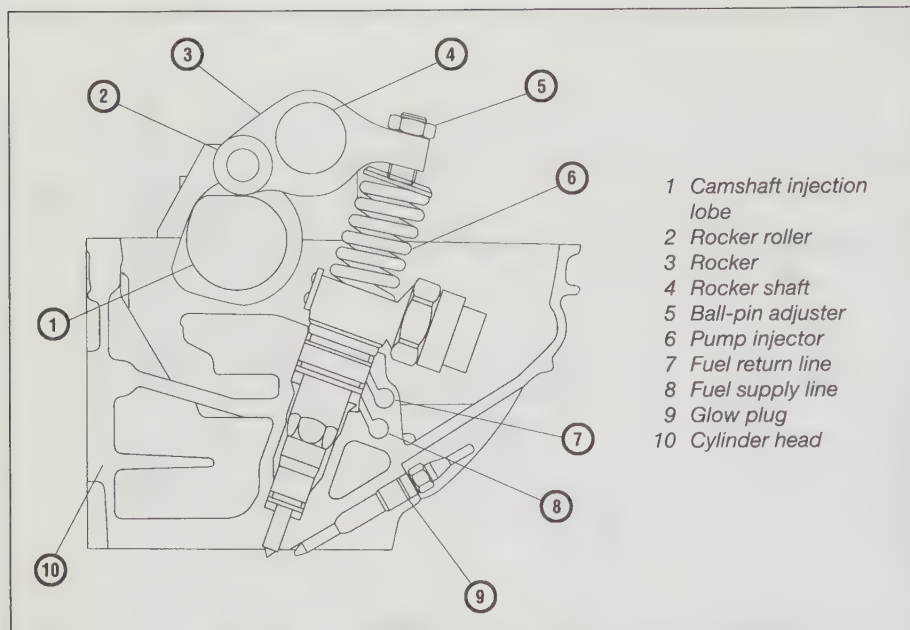
10 'Pump injector' systems

Description

1 The 'pump injector' system has been in use in basic form for some years on larger direct injection diesel engines (**see illustration**). Recent developments in electronic engine control systems have enabled the system to be refined for use on smaller car and light commercial engines, and at the time of writing VW/Audi, and Land Rover were among the major manufacturers selling vehicles equipped with this system. Although there are other types of pump injector system (eg, Lucas EUI), we will use the Bosch type as a typical example to explain the principles involved.

2 As its name implies, a 'pump injector' consists of a fuel injection pump, combined with a fuel injector. Each cylinder of the engine has its own pump injector, which eliminates the need for a separate high-pressure fuel pump, and the associated high-pressure fuel lines.

3 The pump injectors are operated by the engine camshaft, and are able to generate



10.3 Pump injector installation - Bosch/VW pump injector system

extremely high fuel pressures (up to 2000 bar on some systems) (see illustration). The pump injectors are mounted in the cylinder head, and are supplied with fuel via a distributor pipe mounted in the cylinder head. A fuel lift pump pumps fuel from the fuel tank to the distributor pipe. Each pump injector is individually controlled via signals from the

system electronic control unit. The pump injectors are electromagnetically-operated.

4 Pressure limiting valves in the fuel supply and return lines maintain constant fuel pressures in the fuel supply and return lines.

5 Because of the extremely high fuel injection pressure, the fuel in the return line becomes very hot, and a fuel cooling system is used to

cool the excess fuel before it is returned to the tank. Besides the obvious effect on safety, if the fuel was not cooled, the fuel temperature in the tank would rise, which means that the temperature of the fuel supplied to the injectors would also rise. Under high-pressure injection conditions, hot fuel reduces fuel delivery from the injectors; although the ECU can compensate to a reasonable degree for fuel temperature variations, cool fuel gives improved combustion and hence improved engine efficiency.

Operation

6 For the purposes of describing the operation of a pump injector system, the components can be divided as follows; the low-pressure fuel system, the fuel cooling system, the pump injectors and the electronic control system.

Low-pressure fuel system

7 The low-pressure fuel system consists of the following components:

Fuel tank.

Low-pressure fuel lines.

Fuel filter/water trap.

Fuel lift pump (incorporating pressure limiting valve).

Fuel distributor pipe (mounted in cylinder head).

8 The low-pressure system (fuel supply system) is responsible for supplying clean, cool fuel to the pump injectors. Refer to Section 3 of this Chapter for further details of the fuel filter/water trap.

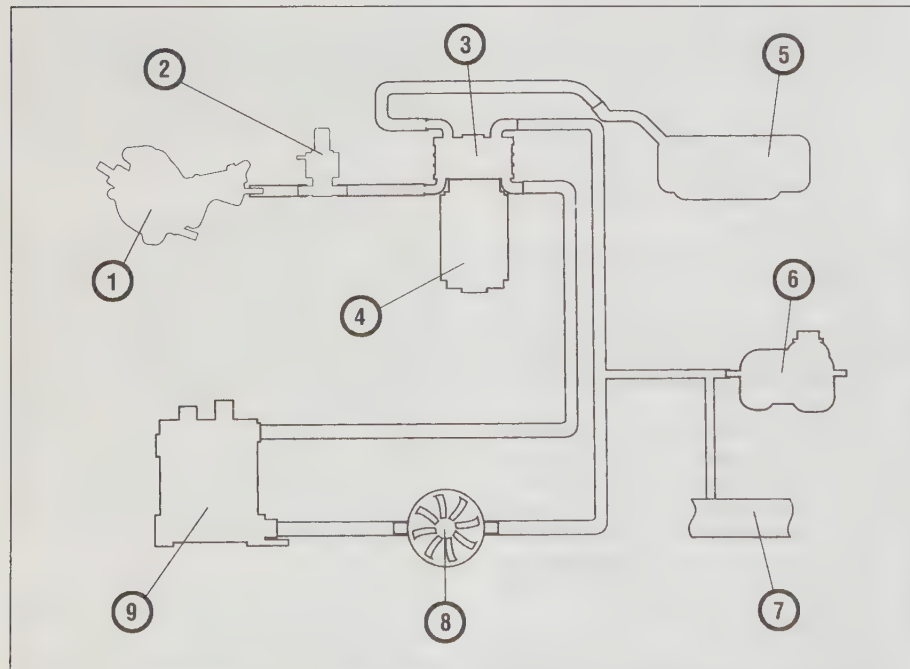
9 After passing through the filter, the fuel reaches the fuel lift pump, which supplies fuel to the fuel distributor pipe, via passages drilled in the cylinder head.

10 Any excess fuel is returned from the distributor pipe to the fuel tank, via the fuel cooling system.

Fuel cooling system

11 The fuel cooling system is separate from the engine cooling circuit, because the temperature of the engine coolant is too high to cool the fuel when the engine is at operating temperature. In most cases, the fuel coolant circuit is connected to the main coolant expansion tank, but in such a way that the hotter engine coolant circuit has no adverse effect on the fuel coolant circuit. The connection to the expansion tank allows the system to be filled, and also allows for expansion of the coolant with varying temperature.

12 A fuel cooler is mounted on the fuel filter head (see illustration). The fuel cooler is basically a fuel/coolant heat exchanger. Cold coolant is pumped through the cooler by an electric pump, controlled by the engine ECU. As the coolant passes through the cooler, it absorbs heat from the fuel. The cooled fuel then passes to the fuel tank, while the warm coolant passes to a radiator at the front of the vehicle. The radiator, which is separate from the engine cooling system radiator, is cooled by the air passing through it due to the



10.12 Schematic view of fuel cooling circuit - Bosch/VW pump injector system

forward motion of the vehicle, supplemented by air from the engine cooling fan(s) when necessary. The cold coolant then passes to the coolant pump, and the cycle starts again.

Pump injectors

13 After passing through the fuel distributor pipe, the fuel reaches the pump injectors (see illustration).

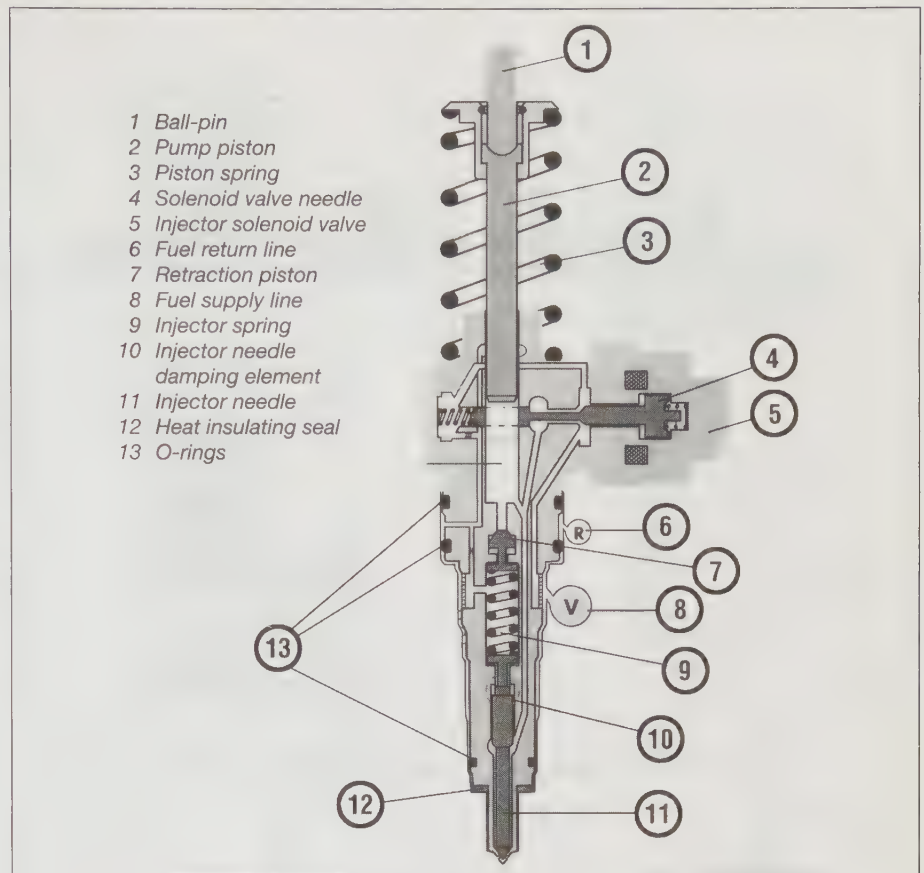
14 The electromagnetically-controlled pump injectors are operated individually, via signals from the ECU, and each injector injects fuel directly into the relevant combustion chamber. The fact that very high fuel pressure is always available allows very precise and highly flexible injection in comparison to a conventional injection pump: for example combustion during the main injection process can be improved considerably by the pre-injection of a very small quantity of fuel. On some systems, the individual control of the injectors also allows individual engine cylinders to be 'switched off' during part-load conditions, to improved fuel economy.

Electronic control system

15 The electronic control system consists typically of the following components:

- Electronic control unit (ECU).*
- Fuel coolant pump.*
- Crankshaft speed/position sensor.*
- Camshaft position sensor.*
- Accelerator pedal position sensor.*
- Air temperature sensor.*
- Coolant temperature sensor.*
- Air mass meter.*
- Inlet manifold pressure sensor.*
- Fuel temperature sensor.*
- Clutch and brake pedal switches.*
- Fuel injectors.*
- Preheating control circuit.*
- EGR valve actuator.*

16 As mentioned in Section 8, the information from the various sensors is



10.13 Cutaway view of pump injector – Bosch/VW pump injector system

passed to the ECU, which evaluates the signals. The ECU contains electronic 'maps' which enable it to calculate the optimum quantity of fuel to inject, the appropriate start of injection, and even pre- and post injection fuel quantities, for each individual engine

cylinder under any given condition of engine operation.

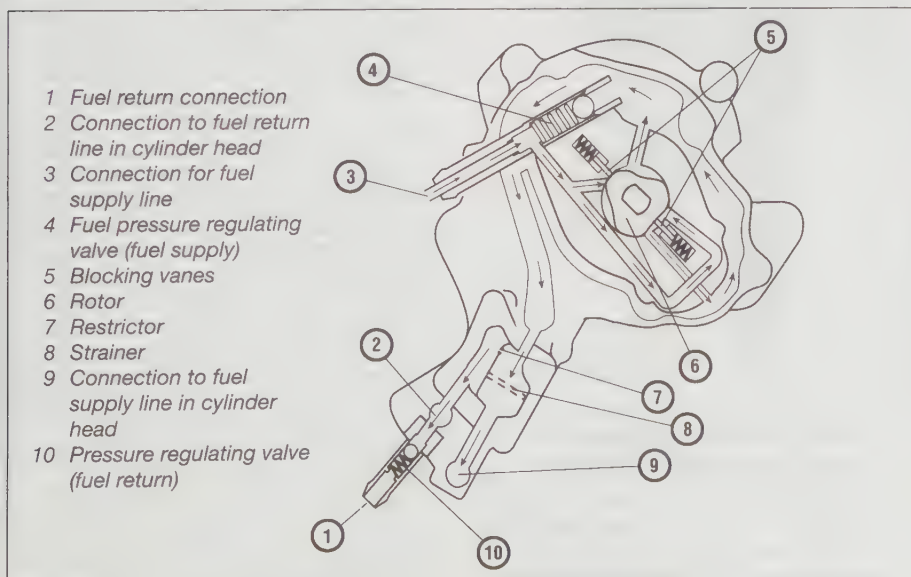
17 Additionally, the ECU carries out monitoring and self-diagnostic functions. Any faults in the system are stored in the ECU memory, which enables quick and accurate fault diagnosis using appropriate diagnostic equipment (such as a suitable fault code reader).

Components

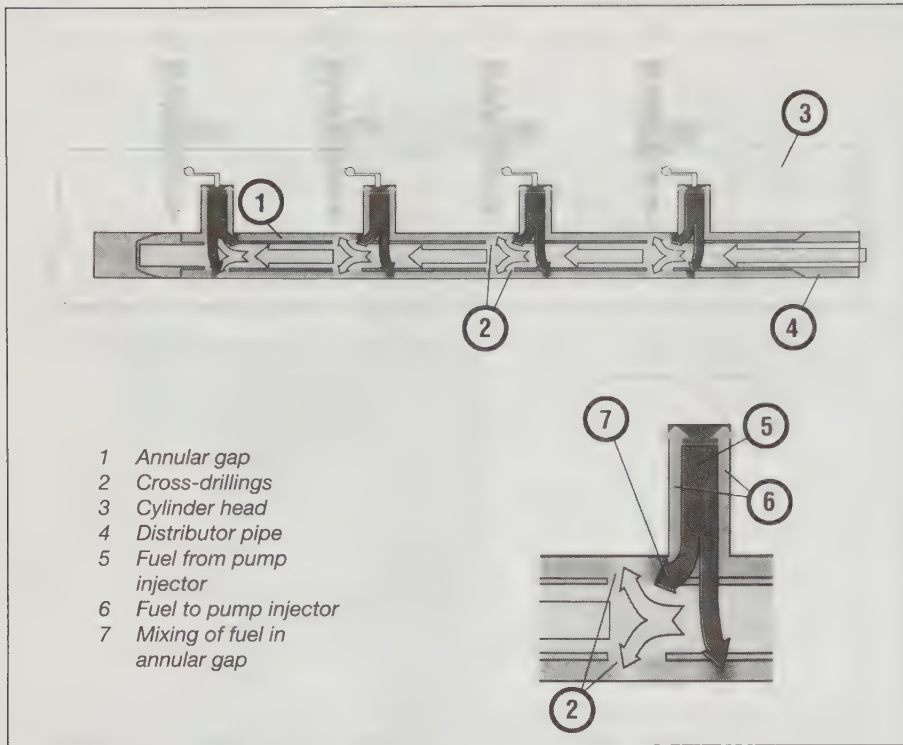
Fuel lift pump

18 The fuel lift pump is normally driven from the end of the engine camshaft. The pump is mounted directly on the cylinder head, and pumps fuel to the distributor pipe via drillings in the cylinder head. The pump incorporates a pressure-limiting valve, which keeps the fuel pressure in the distributor rail constant (approximately 7.5 bar).

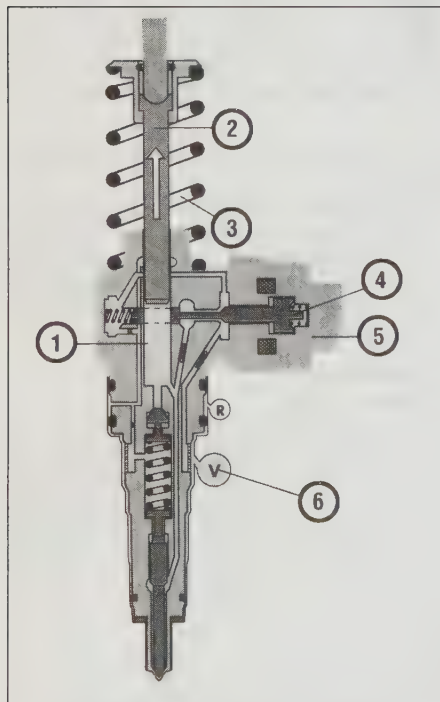
19 The fuel pump is of the blocking vane-cell type, which delivers fuel even at low engine speeds. Fuel is drawn and pumped into two chambers; the intake chamber and feed chamber are separated from each other by spring-loaded blocking vanes. As the pump rotor rotates, it draws fuel from the intake chamber, compresses the fuel, and pumps it out into the feed chamber. As the rotor turns, the blocking vanes slide to maintain the separation between the intake and feed chambers (see illustration).



10.19 Cutaway view of fuel lift pump – Bosch/VW pump injector system

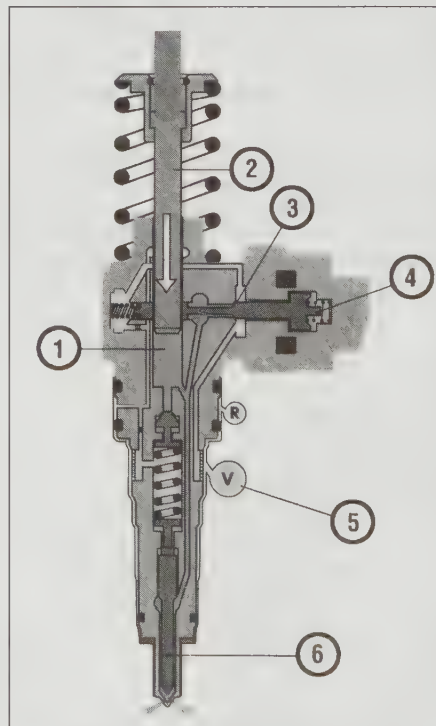


10.20 Fuel distributor pipe – Bosch/VW pump injector system



10.25a Filling of the high-pressure chamber - Bosch/VW pump injector system

- | | |
|-------------------------|---------------------------|
| 1 High-pressure chamber | 4 Solenoid valve needle |
| 2 Pump piston | 5 Injector solenoid valve |
| 3 Piston spring | 6 Fuel supply line |



10.25b Pre-injection commences - Bosch/VW pump injector system

- | | |
|-------------------------|-------------------------|
| 1 High-pressure chamber | 4 Solenoid valve needle |
| 2 Pump piston | 5 Fuel supply line |
| 3 Solenoid valve seat | 6 Injector needle |

Fuel distributor pipe

20 The purpose of the distributor pipe is to distribute fuel evenly to the pump injectors. The pipe is fitted to a passage in the cylinder head, and has a cross-drilling for each pump injector. Fuel supplied by the pump can flow out from the pipe, through the cross-drillings, and into the cylinder head passage which surrounds the pipe. Here, the cool supply fuel mixes with the hot excess (return) fuel forced back into the supply line by the pump injectors (see illustration). This results in the fuel in the distributor pipe being at an even temperature all along the pipe, supplying each pump injector with fuel at the same temperature.

21 If a distributor pipe was not used, and the fuel was pumped to the pump injectors through a closed pipe, the fuel temperature would rise progressively along the pipe: the hot fuel returned by the pump injectors would be forced towards the end of the pipe by the fuel flowing into the pipe from the lift pump. If the temperature of the fuel varied between pump injectors, differing masses of fuel would be injected by each injector, causing unnecessary engine vibration and stress, and excessively high temperatures in the cylinders receiving 'hot' fuel.

Pump injector

22 The pump injectors are mounted directly in the cylinder head. The pumping action is provided by pistons which are operated by additional lobes on the engine camshaft (one lobe for each pump injector), via rocker arms. The injection action is solenoid-activated via signals from the ECU.

23 The injection cam lobe profile can be divided into two sections:

- Steep leading edge* – results in the pump injector piston being pushed down at high velocity, achieving a high fuel pressure very quickly.
- Flat trailing edge* – allows the piston to move up and down slowly and evenly, enabling fuel to flow smoothly into the pump injector high-pressure chamber, free from air bubbles.

24 As the cam lobe turns, it operates the rocker, which in turn operates the pump injector piston, via a ball-pin. The ball-pin is adjustable (in a similar manner to the rocker arms on an engine with adjustable valve clearances), to allow the adjustment of a minimum clearance between the bottom of the pump injector high-pressure chamber and the pump piston. This clearance must exist to prevent the piston from hitting the bottom of the high-pressure chamber when the components expand due to heat.

25 The pump injector injection cycle can be divided into six stages (see illustrations):

- Filling of the high-pressure chamber* – the pump piston moves upwards under the force of the piston spring, increasing the volume of the high-pressure chamber. The injector solenoid valve is not

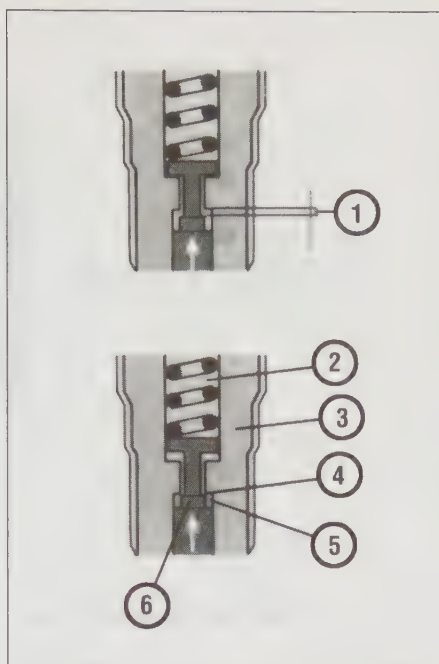
activated at this time. The solenoid valve needle is in its rest position, and the path from the fuel supply line to the high-pressure chamber is open, allowing fuel to flow into the high-pressure chamber.

b) Pre-injection commences – the pump piston moves down under the force of the rocker arm, and pushes fuel out of the high-pressure chamber into the fuel supply line. The ECU activates the injector solenoid valve. The solenoid valve needle is pressed down onto the valve seat, and closes off the path from the high-pressure chamber to the fuel supply line. This causes a build-up of pressure in the high-pressure chamber. When the pressure reaches around 180 bar, it overcomes the pressure of the injector spring, which allows the injector needle to lift. The pressure in the high-pressure chamber forces fuel out through the injector nozzle, and pre-injection commences.

c) Pre-injection damping – during the pre-injection stage, the movement of the injector needle is damped by a hydraulic 'cushion', which allows the quantity of fuel injected to be metered exactly. In the first third of the needle stroke there is no damping, and a quantity of fuel is injected into the combustion chamber. As soon as the damping piston (fitted to the top of the injector needle) moves up into the bore at the bottom of the injector spring chamber, the fuel above the injector needle can only move into injector spring chamber through a small metered gap. This creates a hydraulic 'cushion' which limits the injector needle stroke during the pre-injection cycle.

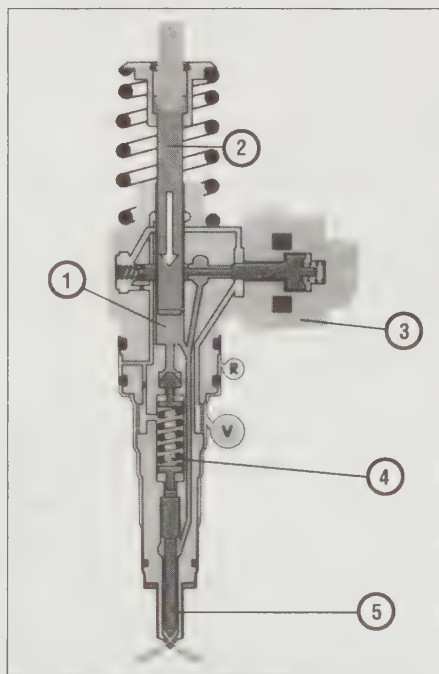
d) Pre-injection ends – the pre-injection cycle ends straight after the injector needle opens. The increasing pressure causes the retraction piston to move downwards, increasing the volume of the high-pressure chamber. As a result, the pressure drops momentarily, and the injector needle closes. The pre-injection cycle now ends. The downward movement of the retraction piston compresses the injector spring, increasing the downward load on the injector needle. This means that to lift the injector needle from its seat during the main injection cycle, the fuel pressure must be higher than during the pre-injection cycle.

e) Main injection commences – the pressure in the high-pressure chamber increases shortly after the injector needle closes. The injector solenoid valve remains closed, and the pump piston moves downwards. When the pressure reaches approximately 300 bar, the fuel pressure overcomes the force exerted by the pre-loaded injector spring. The injector needle lifts, and the main injection quantity of fuel is injected. The fuel pressure rises to approximately 2050 bar, because more



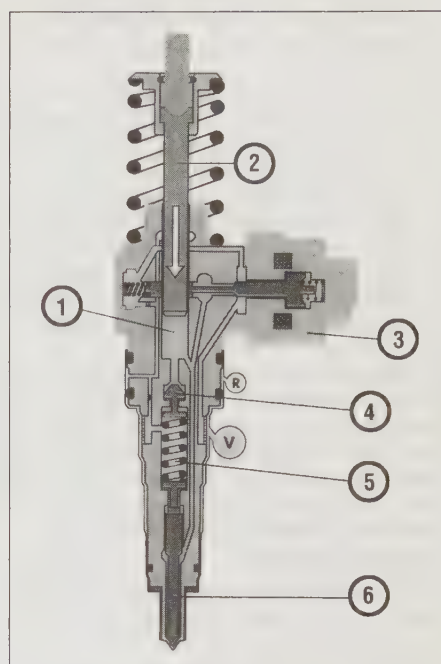
10.25c Pre-injection damping - Bosch/VW pump injector system

- | | |
|---------------------------|---------------------|
| 1 Undamped stroke | 4 Leakage gap |
| 2 Injector spring chamber | 5 Hydraulic cushion |
| 3 Injector housing | 6 Damping piston |



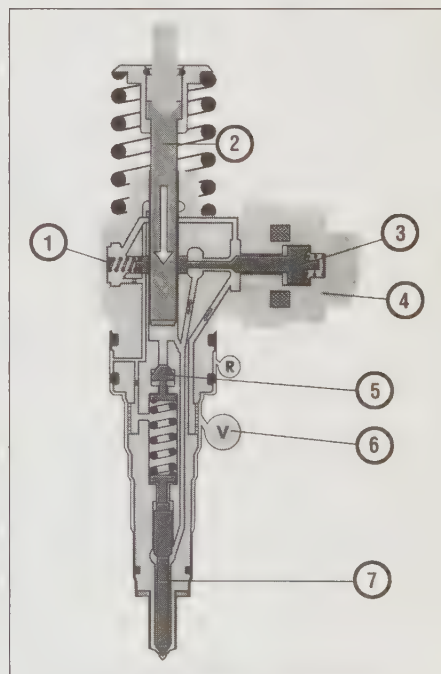
10.25e Main injection commences - Bosch/VW pump injector system

- | |
|---------------------------|
| 1 High-pressure chamber |
| 2 Pump piston |
| 3 Injector solenoid valve |
| 4 Injector spring |
| 5 Injector needle |



10.25d Pre-injection ends - Bosch/VW pump injector system

- | | |
|---------------------------|---------------------|
| 1 Undamped stroke | 4 Retraction piston |
| 2 Pump piston | 5 Injector spring |
| 3 Injector solenoid valve | 6 Injector needle |



10.25f Main injection cycle ends - Bosch/VW pump injector system

- | | |
|-------------------------|---------------------------|
| 1 Solenoid valve spring | 4 Injector solenoid valve |
| 2 Pump piston | 5 Retraction piston |
| 3 Solenoid valve needle | 6 Fuel supply line |
| | 7 Injector needle |

2•54 Fuel injection systems

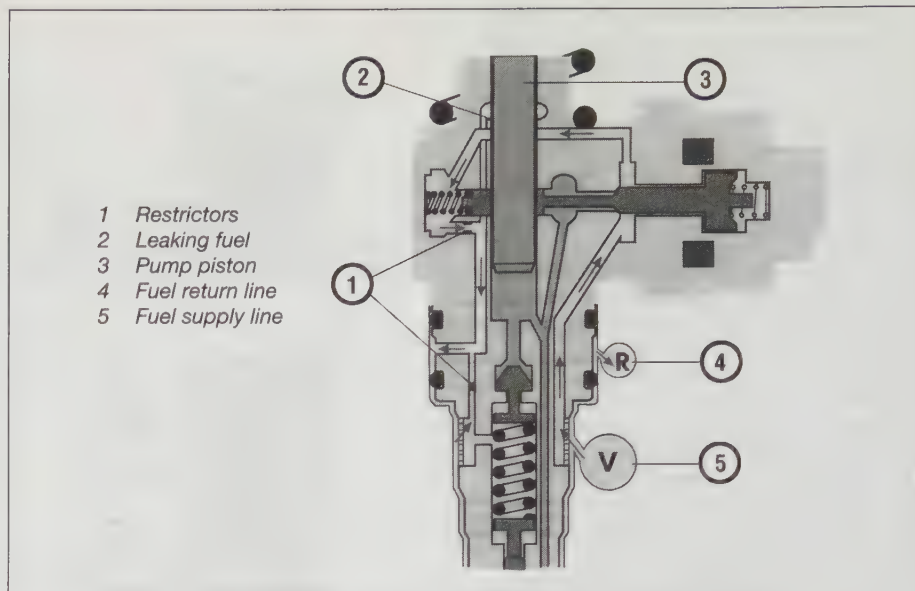
fuel is displaced in the high-pressure chamber than can escape through the nozzle holes.

- f) *Main injection cycle ends – the injection cycle ends when the ECU de-activates the injector solenoid valve. The solenoid valve spring opens the solenoid valve needle, and the fuel displaced by the pump piston enters the fuel supply line, allowing the pressure to drop. The injector needle closes, and the injector spring forces the retraction piston into its rest position. The main injection cycle now ends.*

26 When the engine is running, a quantity of fuel is flushed from the fuel supply line, through ducts in the injector body, into the fuel return line, to cool the injector. The flushing action is provided by fuel pressure, and restrictors in the ducts prevent a significant pressure loss (see illustration).

ECU and sensors

27 The ECU and sensors are described earlier in this Section – see *Description*.



10.26 Injector cooling action - Bosch/VW pump injector system

Chapter 3

Engine electrical systems

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3

1 Introduction

1 By far the majority of faults on small diesel engines are electrical in origin, and can be attributed either to the battery or the preheating system. An understanding of how the electrical systems work and how to test them is important if mistakes in diagnosis are to be avoided. In particular, the injection pump and injectors can receive costly and unnecessary attention when in fact it is the preheating system which is at fault.

2 Apart from the absence of an ignition system, the electrical systems of the small

diesel engine differ from those of the petrol engine in the following areas.

Battery

3 The battery is of larger capacity (expressed as reserve capacity – RC – or amp-hours) than on an equivalent-sized petrol engine. It is also capable of delivering more current (cold cranking capacity). Both these functions are necessary to cope with the higher demands imposed by the starter motor and the preheating system.

4 For satisfactory starting, especially in winter, it is important that the correct type of battery is fitted, and that it is in good condition and well-charged. When fitting a new battery, both the reserve capacity and the cold cranking capacity must be as

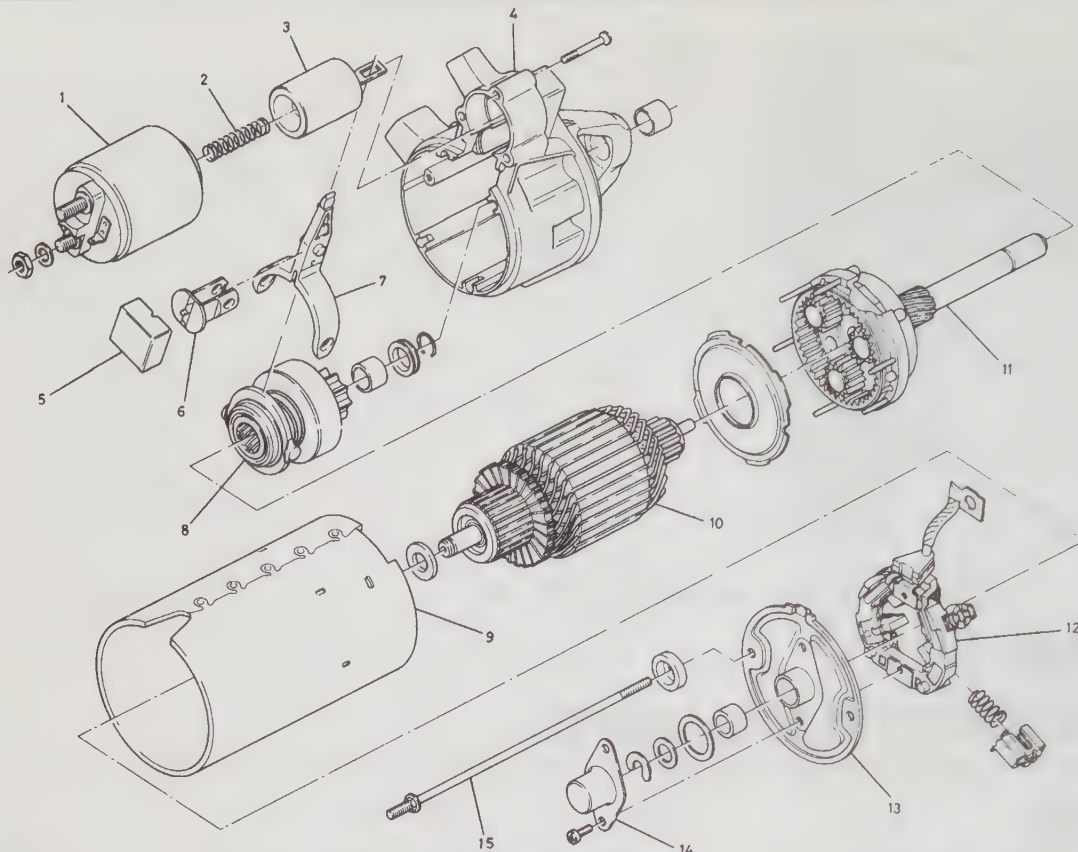
specified. Battery testing is covered later in this Chapter.

Alternator

5 Alternator rated output tends to be higher on the diesel engine, in order to ensure that the battery is recharged in a sufficiently short time after the demands made on it during start-up.

Starter motor

6 Although the cranking speeds required to start petrol and diesel engines are similar, the diesel engine's starter motor needs to provide a higher torque to overcome the greater resistance caused by the high compression ratio. This may be achieved by simply increasing the physical size of the motor, or



1.6 Exploded view of reduction gear starter motor with permanent magnetic field

- | | | | |
|---------------------|--------------------------|------------------------------------|--------------------------|
| 1 Solenoid body | 5 Rubber wedge | 9 Field frame | 12 Brushgear |
| 2 Spring | 6 Operating arm pivot | 10 Armature | 13 Commutator end shield |
| 3 Solenoid plunger | 7 Operating arm | 11 Reduction gear and output shaft | 14 Commutator end cap |
| 4 Drive end housing | 8 Clutch-pinion assembly | | 15 Through-bolt |

by the use of reduction gears (**see illustration**).

7 Some small diesel engine starter motors

use permanent magnets instead of field coils. This, in conjunction with reduction gears, keeps the size and weight of the starter motor down.

Fuel injection pump

8 Most fuel injection pumps have an electrically-operated fuel shut-off valve, usually known as the stop solenoid. The valve opens the inlet bore to the high-pressure chamber when energised (ignition on) (**see illustration**). If it sticks shut, or if its voltage supply is interrupted, fuel cannot reach the pump plunger, and the engine will neither start nor run (see Chapter 9).

Fuel heaters

9 Electrically-operated fuel heaters are fitted as original equipment to some vehicles, or may be encountered as an aftermarket accessory. They are fitted either upstream of the fuel filter, as close as possible, or (with units such as the Lucas/CAV D-Wax) form an integral part of the filter head. See Chapter 2, Section 3 for more details.

10 Fuel heaters are normally thermostatically-controlled, and energised only when the

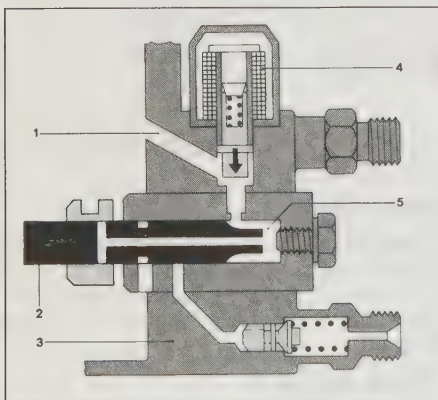
ignition is switched on. Power consumption is of the order of 100 to 200 watts.

Preheating system

11 This is one of the most important engine electrical systems. It is considered in detail in the following Sections.

2 Preheating system - description

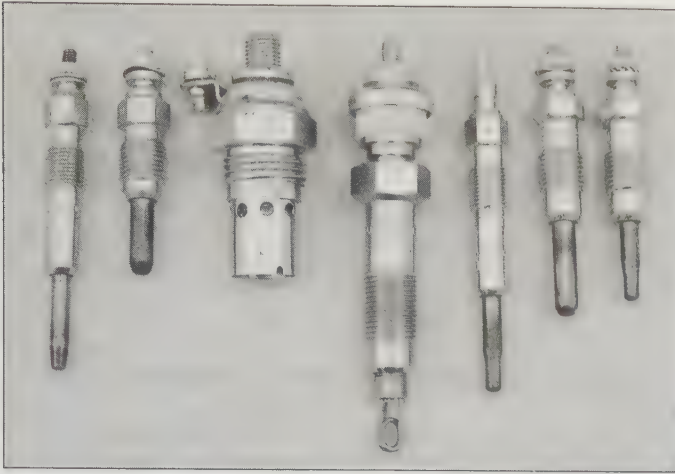
1 The temperatures reached in the cylinders of the diesel engine at cranking speed when cold can be insufficient to ignite the fuel vapour. One way round this is to increase cranking speed, but this would entail the use of much larger (and heavier) batteries and starter motors. A more satisfactory solution is to provide an external source of extra heat just before and during start-up. There are two ways of providing this heat: electrically, by the use of heater plugs (usually called glow plugs), or by a combination of electrical and fuel energy, in the so-called 'flame plug'.



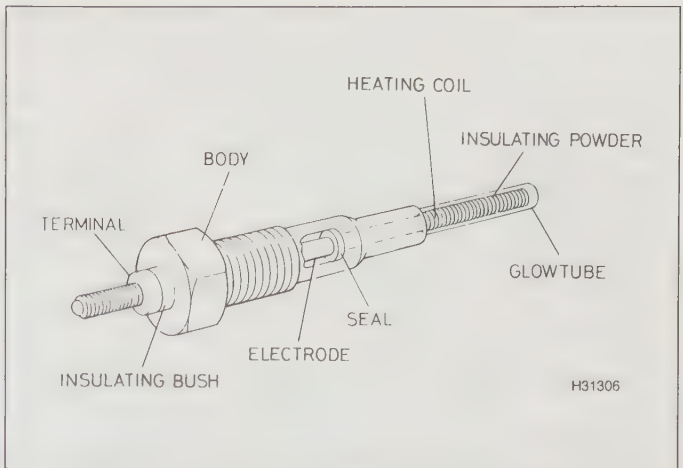
1.8 Stop solenoid fitted to Bosch VE distributor injection pump

© Robert Bosch Limited

- | | |
|--------------------|-------------------------|
| 1 Fuel inlet | 4 Shut-off solenoid |
| 2 Pump plunger | 5 High-pressure chamber |
| 3 Distributor head | |



2.2a A selection of typical glow plug types



2.2b Construction of a sheathed element glow plug

Glow plugs

2 All indirect injection engines, and most direct injection engines, use glow plugs to assist cold starting. Usually, one plug is used per cylinder (sometimes, one cylinder may not be fitted with a plug due to space restrictions). Some engines still use plugs with an exposed element, but modern engines normally use the sheathed-element plug, where the heating element is enclosed and protected by a metal sheath (see illustrations). On all engines in current production, the plugs are wired in parallel so that failure of one plug will not affect the operation of the others.

3 The tips of the glow plugs, which protrude into the pre-combustion or combustion chambers, become red-hot after a few seconds when battery voltage is applied to them. When the incoming fuel spray swirls into contact with the hot plug, the fuel ignites.

4 The time for which the glow plugs need to be energised before the engine can be started will depend on engine temperature and ambient air temperature. The glow plugs are also energised during starter motor operation, and sometimes for a few seconds after start-up. This last phase of operation ('afterglow' or 'post heating') contributes to smooth and smoke-free operation of the engine immediately after starting. Glow plug control circuits are described in the next Section.

5 Glow plugs may last the life of the engine, or one may fail after only a few thousand miles. A four-cylinder engine on which one glow plug has failed can normally still be started without too much trouble, except in very cold weather. With two glow plugs failed, cold starting will be difficult or impossible. It is therefore worth checking the glow plugs at major service intervals, in case one has failed unnoticed.

Flame plugs

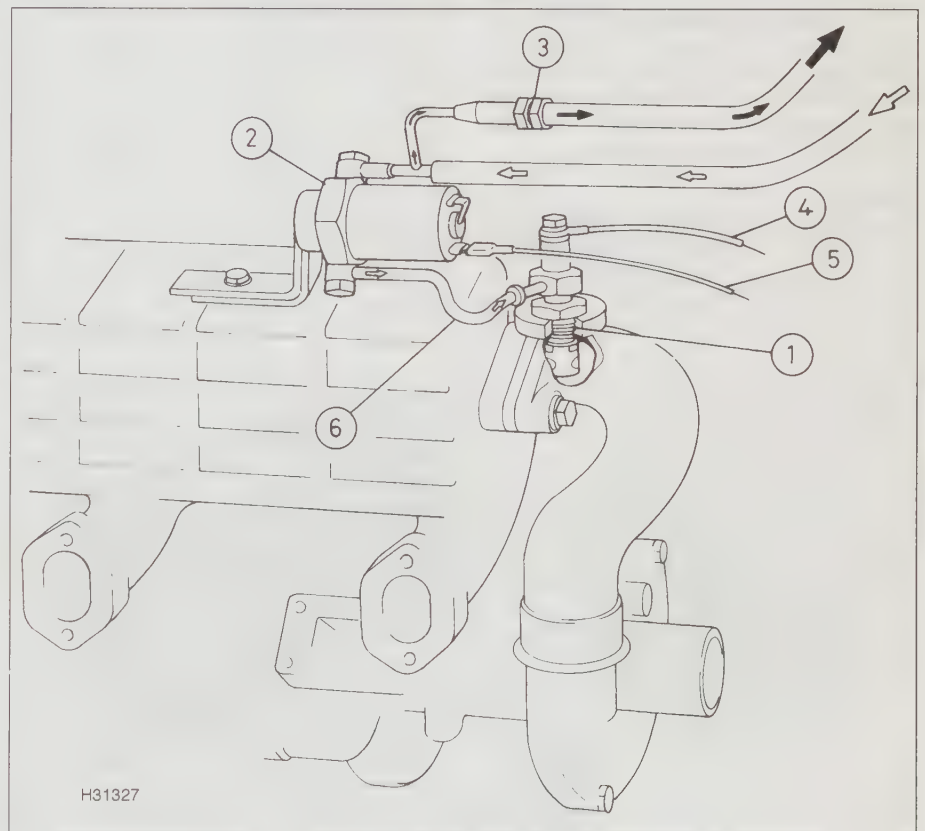
6 Flame plug systems are used on some older types of direct injection engines. Instead of relying on electrical energy for the entire

preheating effect, the flame plug uses electricity to vaporise and ignite fuel fed to it. It is located in the inlet manifold (see illustration).

7 The fuel feed to the flame plug is obtained from the injector return line. Returned fuel fills a small reservoir, located at a higher level than the flame plug, so that when required the fuel

will flow to the plug by gravity. The flow of fuel is controlled by an external solenoid valve, or by a temperature-sensitive valve in the plug itself.

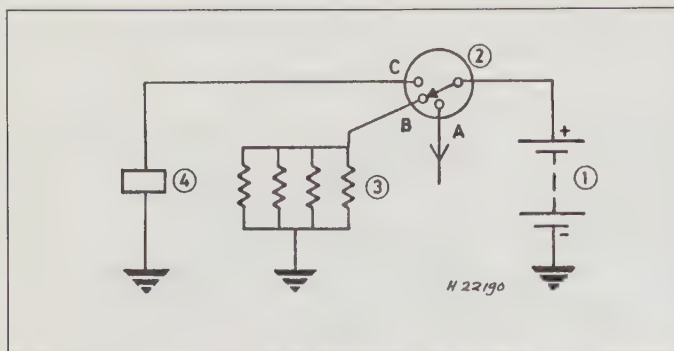
8 The control circuitry for the electrical part of the flame plug is similar to that used for glow plugs.



2.6 Flame plug and associated components on a Fiat engine

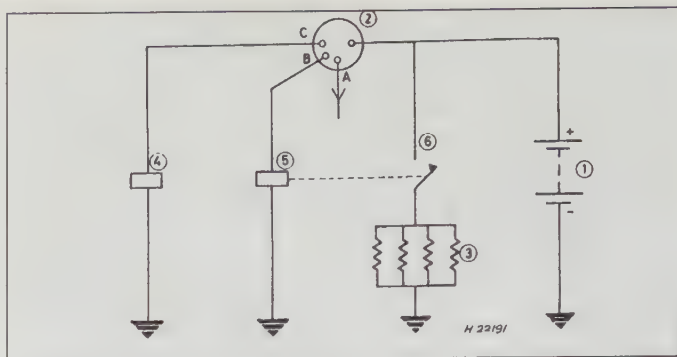
- | | | | |
|---|---------------------------|---|---------------------------------|
| 1 | Flame plug | 4 | Flame plug heating element wire |
| 2 | Solenoid valve | 5 | Solenoid supply wire |
| 3 | Pressure-regulating valve | 6 | Flame plug fuel supply hose |

Light arrows – fuel supply from injection pump return
Dark arrows – fuel return to tank



3.1 Circuit diagram for manually-controlled preheating system

- | | |
|---------------------------|--------------------------------|
| 1 Battery | A Feed in 'run' position |
| 2 Ignition/starter switch | B Feed in 'heat' position |
| 3 Glow plugs | B + C Feed in 'start' position |
| 4 Starter motor solenoid | |



3.2 Circuit diagram for relay-switched preheating system

- | | |
|---------------------------|--------------------------------|
| 1 Battery | 6 Relay contact |
| 2 Ignition/starter switch | A Feed in 'run' position |
| 3 Glow plugs | B Feed in 'heat' position |
| 4 Starter motor solenoid | B + C Feed in 'start' position |
| 5 Relay control winding | |

3 Preheating system control circuits

1 In the simplest form of preheating system, preheating time is controlled by the driver. There is a 're-heat' position on the ignition/starter switch, between the 'run' and 'start' positions, in which the key must be held for a few seconds (up to 30 seconds in very cold conditions) before starting. Once the engine has started and the key is released, the power supply to the glow plugs is switched off (see illustration).

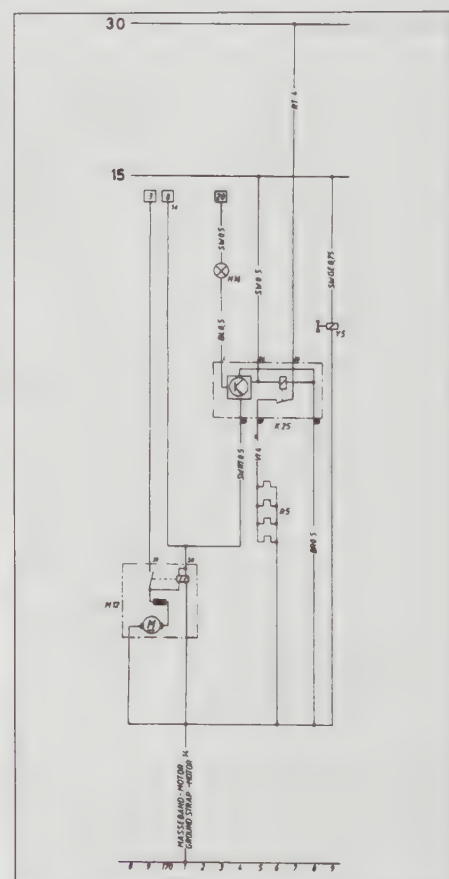
Relays

2 The heavy current drawn by the glow plugs – typically 9 to 12 amps each, with an initial surge two to three times greater – means that most systems make use of a relay to switch the current. A relay is an electrically-operated

switch, which in this case is being used to control a heavy current at a distance from the ignition/starter switch. This eliminates the need to run thick electrical cable to and from the switch, and means that the switch itself can be of lighter construction (see illustration).

Automatic control

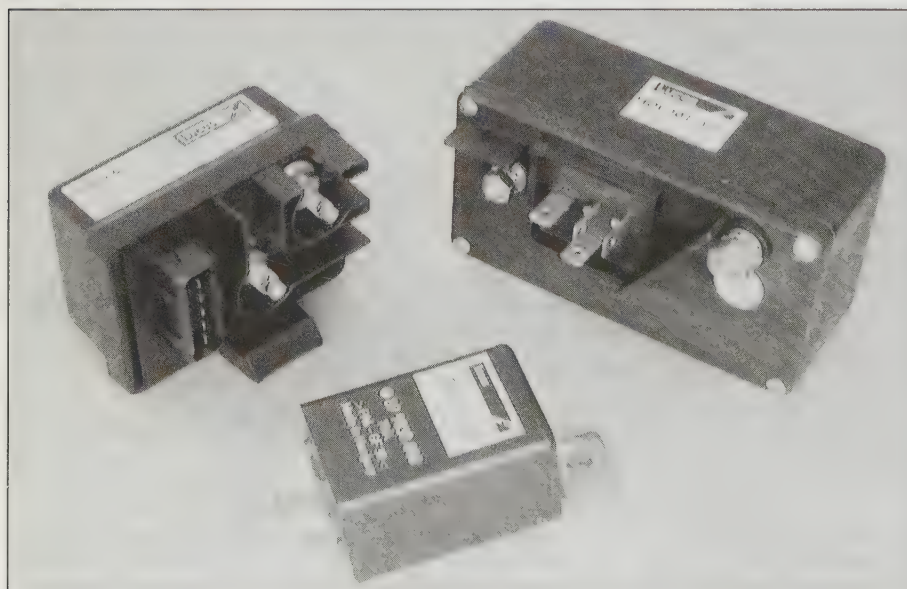
3 In the simplest relay systems, preheating time is still controlled by the driver, but automatic control of preheating time is now virtually universal in passenger cars and light commercial vehicles. On vehicles with electronic diesel engine control, the preheating system is controlled by the engine electronic control unit (in this case the system usually operates in a similar manner to that described for *Advanced systems*, later in this Section). Basic automatic systems incorporate a timer or control unit (which may include the relay) and a preheating warning lamp. Some systems also have a 'ready to start' lamp (see illustrations).



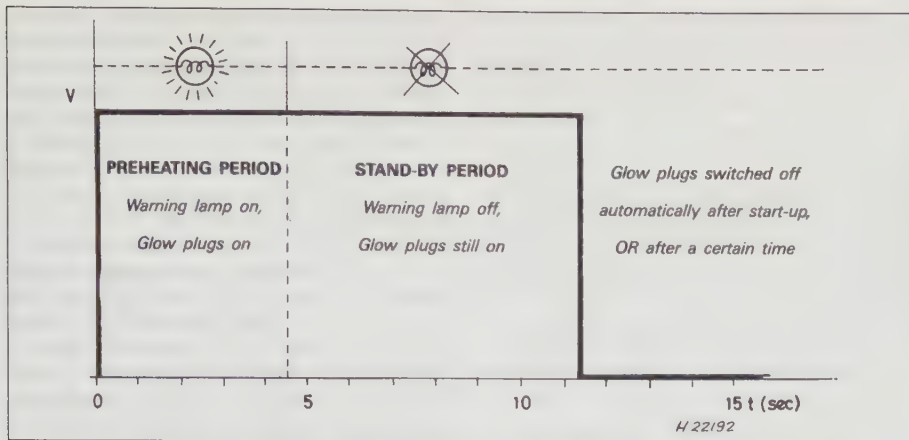
3.3b Circuit diagram for simple automatic preheating system

- | | |
|---------------------|------------------------------------|
| H16 Warning light | 8 From starter switch |
| K25 Glow plug relay | 15 Live rail (ignition-controlled) |
| M12 Starter motor | 30 Live rail (permanent) |
| R5 Glow plugs | |
| Y5 Stop solenoid | |
| 3 From battery | |

Letters and numbers on wires relate to wire colours and thicknesses



3.3a Typical preheating control units



3.5 Glow plug voltage (V) versus time for basic automatic preheating system

4 The control unit responds to under-bonnet air temperature or coolant temperature to determine the preheating time required.

Additional control unit features may include protection against short-circuits, and automatic switching-off of the preheating

circuit if the engine is not started within 30 seconds or so.

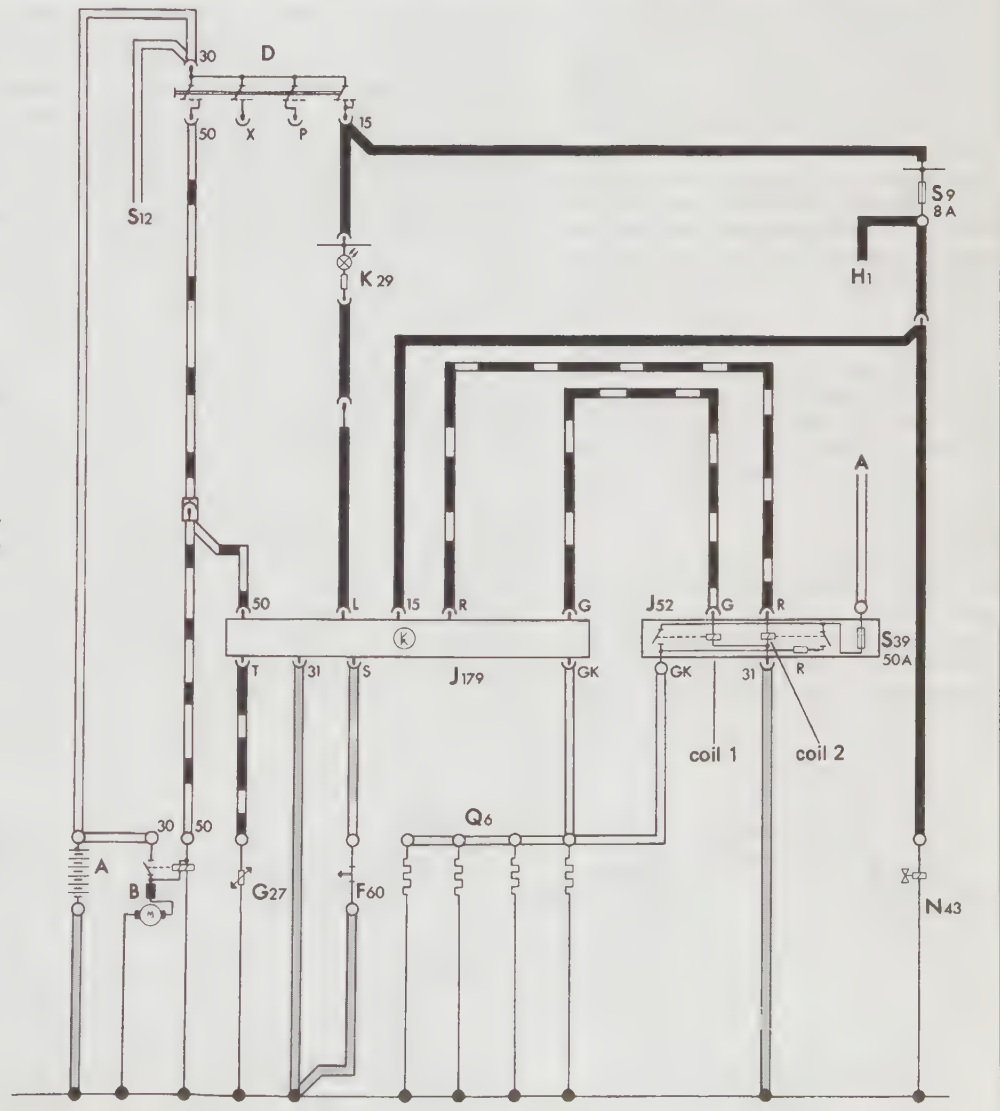
5 The function of the preheating system warning lamp is to advise the driver that the first stage of preheating is taking place. When the lamp goes out, the engine is ready to be started. When testing the preheating system, it is important to understand that the glow plugs are normally still energised after the warning lamp goes out, and remain energised until after start-up, or until a predetermined time has elapsed (**see illustration**). This is known as the 'stand-by' or 'hidden glow' period.

Advanced systems

6 The advanced preheating system shown in the illustration and described in the following paragraphs is fitted to some VW and Audi models from 1987 (**see illustration**). Similar systems are used by many other manufacturers, and on models fitted with

3.6 Circuit diagram for advanced preheating system

- A Battery
- B Starter motor
- D Ignition/starter motor
- F60 Idling switch
- G27 Coolant temperature sensor
- J52 Glow plug relay and resistor
- J179 Control unit
- K29 Preheating warning lamp
- N43 Stop solenoid
- Q6 Glow plugs
- S9 Fuse (in fusebox)
- S39 Glow plug fuse (in relay)



electronic engine control systems, a similar system is usually incorporated within the engine control system. In the example shown, besides the glow plugs themselves, the components of the system are:

- a) An automatic glow period control unit.
- b) A relay, incorporating a fuse, a ballast resistor and a heat sink.
- c) An idling switch which opens when the accelerator pedal is depressed.
- d) A coolant temperature sensor.
- e) A preheating warning lamp.

Preheating

7 When the engine is warm, no preheating takes place. Operation of the system when the engine is cold (coolant temperature below 50°C/122°F) is as follows.

8 The driver turns the ignition switch to position II (run/preheat). The control unit activates coil No 1 in the relay, and the relay contacts close, to supply full battery voltage to the glow plugs. At the same time, the warning lamp comes on, warning the driver that the engine is not yet ready to be started.

9 After the necessary interval, the control unit extinguishes the warning lamp. The length of time taken will depend on coolant temperature. Even though the lamp has gone out, voltage is supplied to the glow plugs for a further 5 seconds, during which time the driver should start the engine. If the engine is not started within this period, the control unit switches off the supply to the relay, so preventing battery drain and overheating of the glow plugs.

Start-up

10 When the driver turns the ignition switch to position III (start), the control unit receives a signal from the wire which feeds the starter motor solenoid. As long as the starter motor is operating, the control unit activates relay coil No 1, and battery voltage is supplied to the glow plugs.

Post-heat

11 With the engine running, the post-heat period begins. For the first 5 seconds after start-up, the control unit continues to activate relay coil No 1, and the glow plugs continue to receive full battery voltage. This is to compensate for the cooling which will have

occurred during starter motor operation, when battery voltage is considerably reduced.

12 After the initial 5 seconds, the control unit monitors the voltage at the glow plugs. When this rises above 11 volts, the control unit activates relay coil No 2. This causes a ballast resistor inside the relay to be switched in series with the glow plugs, which could otherwise be damaged by the increased voltage available with the engine running. If the voltage at the glow plugs drops below 10.3 volts, the control unit switches the resistor out of the circuit again.

13 Post-heat continues to be applied until one or more of the following conditions is met:

- a) Coolant temperature exceeds 50°C/122°F.
- b) Post-heating has taken place continuously for 120 seconds.
- c) The accelerator pedal is depressed for more than 10 seconds.

In the last case, post-heating will be re-applied if the engine returns to idle while it is still cold. Full battery voltage will be applied for the first 5 seconds of the renewed post-heating period, in order to warm the glow plugs quickly. After 5 seconds, the resistor is again switched into circuit.

4 Charging system - testing

Note: *Thorough testing of the charging system is beyond the scope of this book, but the following tests will serve to show if the system is functioning or not.*

1 Begin by checking that the battery terminals and their connections are clean and tight. Also check the alternator connections and the alternator drivebelt.

2 If an ammeter with an inductive clamp connection is available, this may be used in the test procedure in addition to a voltmeter. Connect the clamp round the battery positive lead to measure the total charge or discharge current. The use of a series-connected ammeter is not recommended, partly because of the difficulty of avoiding it having to pass starter motor current, and partly because of the risk of alternator damage if it is

accidentally disconnected or short-circuited.

3 Connect a voltmeter (with a range of 0 to 20 volts approximately) across the battery terminals (**see illustration**). With the engine stopped, switch on the headlights and note the battery voltage, which should be between 12 and 13 volts. If it is lower, the battery is probably in a poor state of charge. Switch off the headlights.

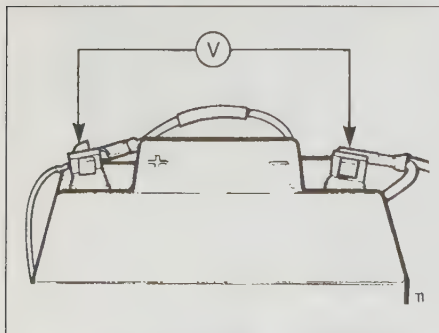
4 Leave the voltmeter connected, and start the engine. Once the engine is running, voltage should rise to around 14 volts. If it does not, the alternator or voltage regulator is probably defective. (Consult the vehicle wiring diagram, or an electrical specialist, to establish if there are any particular features in the system under test which can give a similar result. Some systems incorporate fuses, either in the alternator itself or in the feed to the field windings; others will not work at low rpm if the no-charge warning light bulb has blown.)

5 Increase the engine speed to around 2000 rpm. Voltage may rise a little, but should not exceed 15 volts. If it does, the voltage regulator is defective.

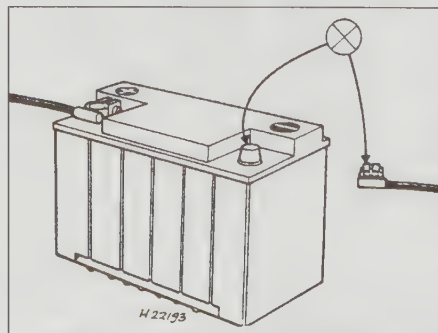
6 With the engine still running at 2000 rpm, switch on as many electrical consumers as possible (headlights, heated rear window, heater blower, etc). Voltage may fall a little, but should not go below 14 volts. If voltage falls much below this, and raising the engine speed will not bring it back up, this shows that the alternator is not producing an adequate output, and should be investigated further. If an engine analyser with an oscilloscope is available, this may be used to examine the alternator output waveform to see if all three phases are present.

7 Switch off electrical consumers, and stop the engine. Disconnect the voltmeter, then disconnect the battery earth lead. Use a test lamp or an ammeter connected between the earth terminal and the earth lead to verify that with everything switched off, no current drain is taking place (**see illustration**). (Items such as clocks and alarm systems should draw only a negligible current – certainly not enough to light a bulb.) If a drain appears to be taking place, remove the fuses one at a time to see which circuit is responsible.

8 If the current drain does not stop in relation to any fuse, try the effect of disconnecting the alternator. If this stops the drain, leakage is taking place through the alternator diodes; the diodes or the alternator itself must be renewed.



4.3 Voltmeter connected across battery terminals



4.7 Checking for current drain using a test lamp

5 Battery - testing



Warning: Battery acid is poisonous and corrosive. Take care not to get it on clothing or skin, or in the eyes. In the case

of accidental contact, wash off at once with plenty of cold water. If acid has splashed into the eyes, seek immediate

medical assistance as well. The gases given off by the battery during charging and testing are explosive. Do not smoke or cause sparks, or allow naked lights near the battery.

1 If battery problems are suspected and the charging system is known to be in order (Section 4), first make sure that the battery terminals and their connections are clean and tight. Also clean the top of the battery – discard the rag used for cleaning.

2 If the cell covers or plugs can be removed, check the electrolyte level and top up with distilled water if necessary. If one cell requires much more topping up than the others, this should be viewed with suspicion.

3 Check the specific gravity of the electrolyte with a hydrometer. This will give an idea of the overall state of charge, but more importantly will show up weak or failing cells, which will have a reading noticeably different from the good cells.

4 The most useful test of battery condition is to measure its terminal voltage during heavy discharge. It is this value which determines whether or not the battery can provide satisfactory cold starting performance. As a simple test, the terminal voltage can be measured while an assistant operates the starter motor. (Disconnect the stop solenoid, or manually operate the stop lever on the pump to prevent the engine starting.) If the battery is fully charged, but the voltage falls below 9.6 volts during cranking, it is almost certainly defective.

5 A purpose-made battery tester is a more satisfactory means of determining battery condition.



Warning: Older types of battery tester (consisting of a basic resistor, voltmeter and connecting tongs or leads) can

produce sparks at the battery terminals – take care as this can cause the battery to explode.

6 Modern electronic battery testers are safe to use, and will not produce sparks around the battery terminals.

6 Starter motor circuit - testing

Starter motor turns slowly

1 If the battery is fully charged and in good condition, but the starter motor turns slowly, there are three possibilities:

- There is an excessive electrical resistance in the starter motor circuit.*
- There is a fault in the starter motor itself.*
- The engine is abnormally stiff to turn (mechanical problem or oil viscosity high).*

2 This Section deals with finding whether the problem is in the starter motor circuit or in the starter motor itself, and locating the problem if it is in the circuit.

3 Because the currents involved are very high, even a small resistance will have a large effect on the circuit. (Any point in the circuit where the resistance is higher than it should be will get hot when the starter motor is operated, and it may be possible to locate dirty or corroded connections by feeling them to detect this heating.) Such small levels of resistance cannot be measured with a conventional ohmmeter, so voltage drop tests are carried out with the starter motor operating.

4 To carry out the tests, an accurate voltmeter capable of reading fractions of one volt will be required. A high-range ammeter (0 to 400 amps or so) with an inductive clamp

pick-up would be useful, but is not essential. Some engine analysers incorporate suitable voltage and current measuring facilities.

5 If the ammeter is available, position the clamp on the battery-to-starter motor lead, and read the current drawn when the starter motor is operated. (Disconnect the fuel cut-off solenoid, or operate the pump stop lever, to prevent the engine from running.) A current draw of around 350 amps is typical. If it is higher, the circuit is in good condition, and there is a problem in the starter motor or the engine. If it is lower, carry on as follows.

Positive-side checks – solenoid mounted on starter motor

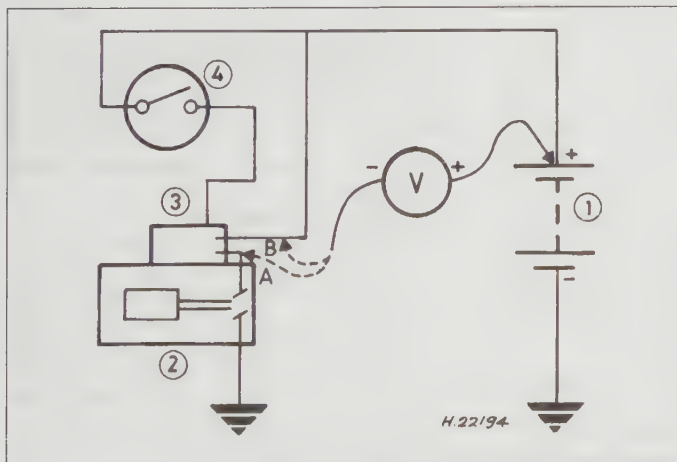
6 Measure the voltage between the battery positive terminal and the starter motor positive terminal (the output side of the solenoid), while an assistant operates the starter motor (**see illustration**). The value obtained is the total voltage lost in the positive side of the starter motor circuit. The maximum acceptable loss is 0.5 volt; on a new system in good condition, 0.25 volt would be expected.

7 Repeat the test, but this time measure the voltage between the battery positive terminal and the input (battery) side of the solenoid. The difference between the first and second measurements is the voltage lost in the solenoid.

Positive-side checks – solenoid remote from starter motor

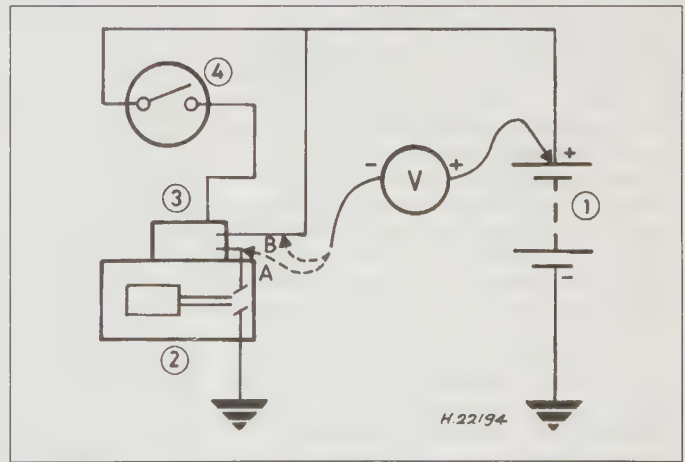
8 Take a reading between the battery positive terminal and the starter motor positive terminal while the starter motor is operated, as just described above (**see illustration**).

9 Take a second reading between the battery positive terminal and the solenoid output terminal. The difference between the first and second readings is the voltage lost in the



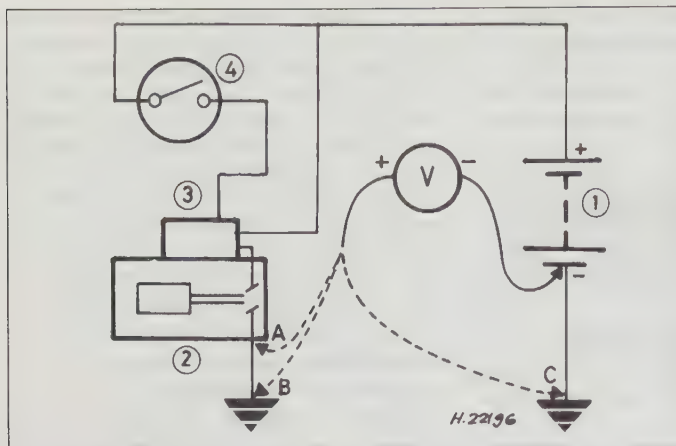
6.6 Starter motor voltage drop test points on positive side (solenoid on motor)

- | | |
|-----------------|--|
| 1 Battery | 4 Ignition/starter switch |
| 2 Starter motor | A Solenoid output/motor input terminal |
| 3 Solenoid | B Solenoid input terminal |



6.8 Starter motor voltage drop test points on positive side (remote solenoid)

- | | |
|---------------------------|----------------------------|
| 1 Battery | A Motor positive terminal |
| 2 Starter motor | B Solenoid output terminal |
| 3 Solenoid | C Solenoid input terminal |
| 4 Ignition/starter switch | |



6.13 Starter motor voltage drop test points on negative side

- | | |
|---------------------------|-------------------------|
| 1 Battery | A Starter motor body |
| 2 Starter motor | B Engine earth strap |
| 3 Solenoid | C Battery negative lead |
| 4 Ignition/starter switch | |

solenoid-to-starter motor cable. If the loss is more than 0.25 volt, clean and tighten the cable connections. If no improvement results, renew the cable.

10 Take a third reading between the battery positive terminal and the solenoid input terminal. The difference between the second and third readings is the voltage drop in the solenoid.

All solenoid types

11 If the loss in the solenoid is greater than 0.25 volt, remove it for cleaning or renewal.

12 If the loss in the battery-to-solenoid cable is greater than 0.25 volt, clean and tighten its connections. If no improvement results, renew the cable.

Negative-side checks

13 Measure the voltage between the battery negative terminal and the starter motor body, with the starter motor operating (see illustration). The value obtained is the voltage lost in the whole of the negative side of the circuit. It should not exceed 0.25 volt.

14 Take a second measurement between the battery negative terminal and the body or chassis end of the earth strap, if this is separate from the battery negative lead. The difference between the first and second measurements is the voltage lost in the earth strap. If it is greater than 0.25 volt, clean and tighten the earth strap connections. If no improvement results, renew the strap. (Note that if the earth strap is loose or missing, earth return may take place through control cables, the speedometer cable, wheel bearings or similar, sometimes with bizarre results. Cases have been known of wheel bearings being damaged by high current flowing through them.)

15 Take a third measurement between the battery negative terminal and the far end

(engine or body attachment) of the battery negative lead. The value obtained is the voltage lost in the battery negative cable. If it is greater than 0.25 volt, clean and tighten the cable connections. If no improvement results, renew the cable.

Starter motor does not turn at all

16 Apart from total seizure of the engine (and always assuming that the battery is in good condition), there are three possible reasons why the starter motor will not turn:

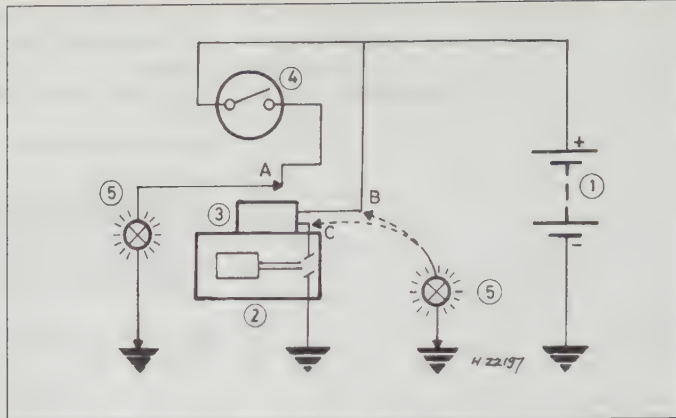
- The solenoid is not completing the circuit.
- There is a high electrical resistance in the circuit.
- There is a fault in the starter motor.

17 To make the following tests, an ordinary voltmeter (0 to 20 volts) or a 12-volt test lamp will suffice.

18 Disconnect the command (small) lead from the solenoid. Connect the voltmeter or test lamp between the lead and earth (vehicle metal) (see illustration). Have an assistant operate the starter switch: voltage should be present when the switch is operated, and should disappear when it is released. If not, there is a break in the wiring between the switch and the solenoid, or a fault in the switch. (On automatic transmission models, it is also possible that the starter inhibitor switch is defective or mal-adjusted.)

19 Reconnect the command lead to the solenoid. Connect the voltmeter or test lamp between the input (battery side) terminal of the solenoid and earth. Voltage should be present here all the time, regardless of the position of the starter switch. If not, there is a break or a bad connection in the battery-to-solenoid lead.

20 Connect the voltmeter or test lamp between the output (motor side) terminal of the solenoid and earth. Have the assistant



6.18 Testing for voltage at the starter motor solenoid using a test lamp

- | | |
|---------------------------|----------------------------|
| 1 Battery | 5 Test lamp |
| 2 Starter motor | A Command lead |
| 3 Solenoid | B Solenoid input terminal |
| 4 Ignition/starter switch | C Solenoid output terminal |

operate the starter switch again: full battery voltage should be present when the switch is operated, and should disappear when it is released. If not, the solenoid is faulty.

21 If the solenoid is remote from the starter motor, connect the voltmeter or test lamp between the starter motor positive terminal and earth. Have the assistant operate the starter switch again. If voltage was present at the solenoid output terminal but does not appear at the motor, the solenoid-to-motor cable is broken or loose.

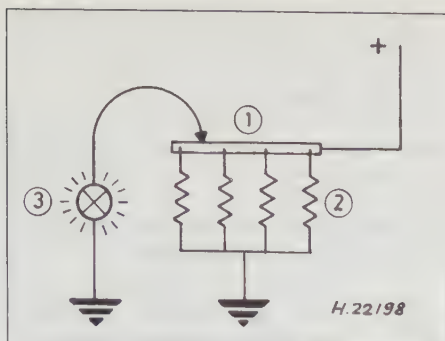
22 If it is established that full battery voltage is reaching the starter motor, but the motor is not turning (and assuming that the negative earth strap is intact and securely connected), there is a fault in the starter motor. Remove it for examination or renewal.

7 Preheating system - testing

1 Testing of the preheating system falls into three areas:

- Voltage supply checks.
- Glow plug or flame plug checks.
- Control circuitry checks.

2 The minimum equipment required is a 12-volt test lamp. More detailed testing will require a multimeter with the appropriate voltage and current ranges. For the professional, there exists dedicated test equipment such as the glow plug and circuit tester described later in this Section. On models with an electronic engine control system, if the system is equipped with a self-diagnostic facility, the system will store an appropriate fault code in the electronic control unit (ECU) memory if there is a fault in the preheating system (see Chapter 2, Section 8, and Chapter 9).



7.4 Checking for glow plug supply voltage with a test lamp

- 1 Glow plug supply wire 2 Glow plugs
3 Test lamp

3 Test procedures given here are of a general nature.

Voltage supply checks with a test lamp or voltmeter

4 Connect the test lamp or voltmeter between the glow plug or flame plug supply wire and earth (vehicle metal) (**see illustration**). Do not let the live side connections touch earth. Have an assistant energise the preheating system. The test lamp should light brightly, or the voltmeter should read at least 10 volts. (A few Japanese engines use 5-volt glow plugs; on these, a reading of 5 or 6 volts is to be expected.)

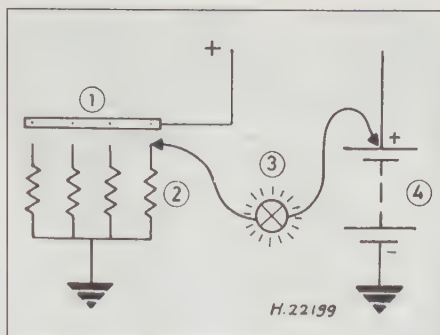
5 If there is no voltage at all, this suggests a fault such as a blown fuse, a disconnected wire, a defective relay, or a defective switch (depending on the type of system – refer to the circuit diagram). A blown fuse may only be a pointer to some underlying fault, such as a short-circuit in the wiring or a glow plug which has failed so as to cause a short. The fuse itself may be incorporated in the relay, or it may take the form of a fusible link in the feed wire near the battery.

6 If the voltage is low and the battery is in good condition, this suggests a bad connection somewhere in the wiring, or possibly a faulty relay.

7 On systems which control preheating time automatically, a check should now be made of the duration for which the voltage is applied. Remember that on most systems, preheating voltage continues to be applied after the warning lamp has gone out.

Glow plug checks with a test lamp or multimeter

8 A simple continuity check can be made by disconnecting the wire or metal strap which links the glow plug terminals (ignition off), then connecting the test lamp between the battery positive terminal and each glow plug terminal in turn (**see illustration**). Alternatively, measure the resistance between each glow plug terminal and earth. The lamp should light brightly, or the meter read a very low resistance (typically 1 ohm or less).



7.8 Checking glow plug continuity using a test lamp

- 1 Glow plug supply wire 2 Glow plugs
3 Test lamp (disconnected) 4 Battery

9 If the lamp does not light or the meter shows a high resistance, the glow plug has failed open-circuit, and must be renewed.

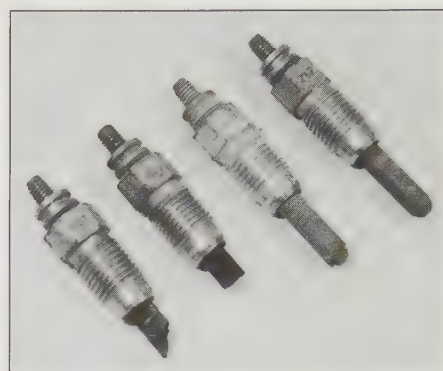
10 The above is only a rough test, and will not detect a glow plug which has failed so as to cause a short-circuit, or one which is no longer heating properly, even though its resistance is still more or less correct. More accurate testing requires the use of an ammeter, of range 0 to 25, or 0 to 30 amps. It should incorporate some kind of overload protection, either in the instrument itself, or by means of a fuse in its lead.

Note: The procedure which follows applies to glow plugs which operate at full battery voltage, as is the case with most models. It does not apply to the 5-volt glow plugs fitted to some Japanese engines. For testing such plugs, a 6-volt source can safely be used.

11 Connect the ammeter between the battery positive terminal and one of the glow plugs. (The glow plugs must still be disconnected from each other.) Note the current draw over a period of 20 seconds or so. Typically, an initial surge of 20 amps or more will fall over 10 to 15 seconds to a steady draw of 9 or 10 amps. A very high draw indicates a short-circuit; a very low draw indicates an open-circuit.

12 Repeat the current draw check on the other glow plugs, and compare the results. Obvious differences such as a very high or very low draw will not be hard to spot. A difference in the rate at which the current falls off is also significant, and may indicate that the glow plug in question is no longer heating at the tip first.

13 So far, the tests have concentrated on the electrical condition of the glow plugs. Their physical condition is also important. To establish this, they must be removed (Section 8) and inspected for burning or erosion. Damage can be caused by a fault resulting in too long a post-heating time, but it is more often due to an injector fault (**see illustration**). If damaged plugs are found, the injectors in the cylinders in question should be removed and checked for spray pattern and calibration.



7.13 Damaged glow plugs

14 As a final check, the glow plugs can be energised while they are out of the engine, and inspected to see that they heat evenly. The tip should glow first, with no local hot or cold spots. Some means of supporting the plug while it is being tested must be devised, and the power supply lead should be fused, or should incorporate some other overload protection. Ideally, a purpose-made glow plug tester with a hot test chamber should be used.

15 Any plug which takes much longer than specified for its tip to glow red, or which shows uneven heating, should be renewed.

Glow plug check using a glow plug tester

16 The following paragraphs describe the use of a typical glow plug tester, the Dieseltune DX 900. For other makes of tester, refer to the manufacturer's instructions.

Note: For testing the 5-volt glow plugs fitted to some Japanese engines, a resistor must be used to reduce battery voltage. A suitable resistor is available from the test equipment manufacturers.

Voltage supply

17 Disconnect the connecting wire or strap from the glow plugs (or from all but one, if preferred – but make sure that the bare ends cannot touch earth). Disconnect the feed wire from the connecting wire or strap.

18 Connect the tester leads as follows:

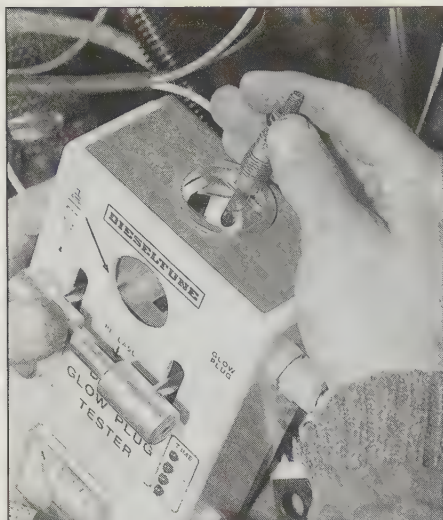
Black to earth or battery negative.

Red to the feed wire (from the relay or timer).

Yellow to one glow plug terminal.

19 Sit in the driver's seat and hold the tester. Press and hold the 'test' button, and energise the pre-heating system (by switching on the ignition, on most models). The ammeter will show the current being drawn by one glow plug as long as the system is energised.

20 Check that current is being drawn while the preheating warning lamp is lit, and (on most systems) for some seconds after the lamp goes out.



7.25 Placing a glow plug into the hot test chamber

Glow plugs – testing in the engine

21 With the glow plugs still disconnected from each other, connect the tester leads as follows:

Black to earth or battery negative.

Red to battery positive.

Yellow to one glow plug terminal.

22 Press and hold the 'test' button, and note the current draw shown on the ammeter. The timer LEDs on the tester will illuminate at 5-second intervals; note how long it takes for the current draw to stabilise, and what the final draw is. (If the glow plug is open-circuit, there will be no draw at all. If there is a short-circuit, the overload cut-out on the tester will trip.)

23 Release the 'test' button. Transfer the yellow lead to the next glow plug terminal, and repeat the test. Carry on until all the glow plugs have been checked.



7.26 Hot testing a glow plug

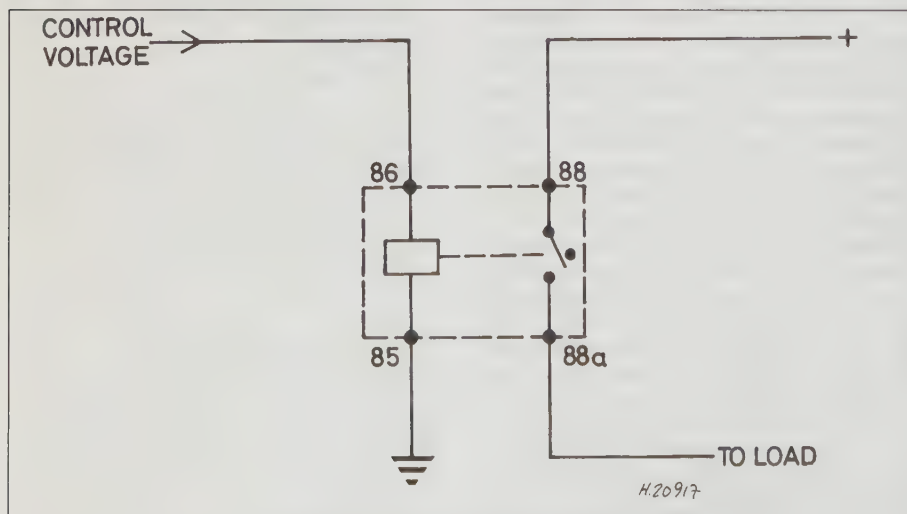
24 Any glow plugs which show abnormal current draw characteristics should be removed (Section 8) for hot testing as follows.

Glow plugs – hot testing

25 Place the glow plug in the hot test chamber, clamping it in place with the spring-loaded bar (see illustration). Connect the yellow lead to the glow plug terminal, leaving the red and black leads connected to the battery.

26 Press and hold the 'test' button, and observe the glow plug through the test chamber window (see illustration). Note the time taken (as indicated by the timer LEDs) for the tip of the plug to glow red hot. If the plug takes longer than specified to glow, or if heating is uneven or starts elsewhere than at the tip, it should be renewed.

27 Release the test button and disconnect the yellow lead from the glow plug.



7.30 Preheating control relay schematic

85 Control winding negative side

86 Control winding positive side

88 Live feed for switched contact

88a Switched output (live when energised)



Warning: The glow plug will still be very hot. Allow it to cool before removing it from the tester.

28 When testing is complete, refit the old glow plugs or fit new ones, as necessary, and remake the original electrical connections.

Control circuitry checks using a test lamp or multimeter



Warning: On vehicles with advanced preheating systems controlled by an electronic diesel control system, it is

advisable NOT to attempt to test the control circuitry using a test lamp or multimeter. Such test equipment can cause serious damage to ECUs and delicate electronic components if mis-used.

29 The procedures given here are intended as a general guide. Refer to the manufacturer's information or to the relevant Haynes Service and Repair Manual for specific details.

Relays

30 The simplest type of relay is an electrically-operated on-off switch. It has four connections, two for the control winding, and two for the circuit being switched. These are shown in the accompanying illustration (see illustration). The terminal numbers used correspond to the widely-used German standard (DIN); vehicles manufactured in other countries may use a different numbering system. Terminal 85 is the control winding negative (earth) side, while terminal 86 is the winding positive side. Terminal 88 is the live feed for the switched contact, and terminal 88a is the switched output.

31 To test the relay and its circuit, unplug the relay from its socket. Connect a voltmeter (0 to 20 volts approx) or a 12-volt test lamp between socket terminal 86 and earth. Energise the system (eg, by selecting the pre-heat position of the ignition/starter switch, if this is the circuit being tested). The voltmeter should indicate battery voltage, or the test lamp should light: if not, there is a fault in the control circuit or switch.

32 Measure the voltage between socket terminal 88 and earth. Again, battery voltage should be indicated, or the test lamp should light: if not, there is a fault in the supply circuit (perhaps a blown fuse, if applicable).

33 Using a multimeter set to measure resistance, or a self-powered test lamp, check for continuity between socket terminal 85 and earth. If there is no continuity, there is a fault in the wiring or the earth connection.

34 Turning to the relay itself, check for continuity between the winding terminals (85 and 86). If there is no continuity, the relay is certainly defective.

35 Check for continuity between the switched contact terminals (88 and 88a). There should be no continuity. Leave the

continuity tester connected, and apply battery voltage to the winding terminals. There should be an audible click, and continuity should be displayed: if not, the relay is defective. (Note that the 'click' alone is not a guarantee of correct operation, since the contacts may be defective while still producing a noise.)

36 A slightly more complicated relay which may be encountered is the changeover type (see illustration). This works in the same way as the on-off relay, but it has an extra switch contact (87a), which is closed until the relay is energised. When testing this relay, continuity should be displayed between terminals 87a and 88 when the winding is not energised, and between terminals 88 and 88a when it is.

Control units

37 Refer to the manufacturer's information or to the relevant Haynes *Service and Repair Manual* for specific details of testing control units. Note that on control units incorporating semiconductors, care should be taken not to apply incorrect loads or voltages. In particular, incorrect use of a test lamp may cause damage to such units.

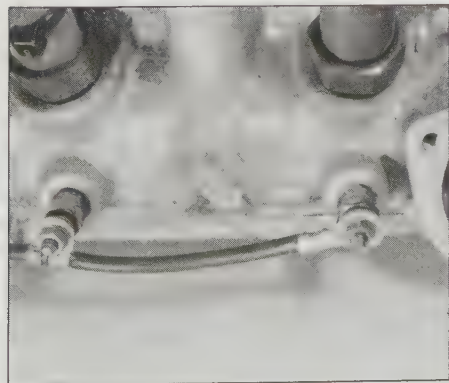
Temperature sensors

38 When a control unit receives a signal from a coolant temperature sensor, a quick way of testing the operation of the sensor is to disconnect it and observe the effect on preheating time. On most systems, disconnecting the sensor will result in an increased preheating time, since sensor resistance rises as temperature falls.

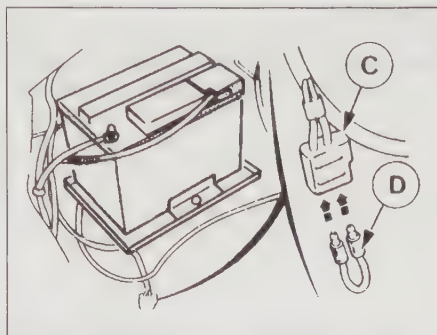
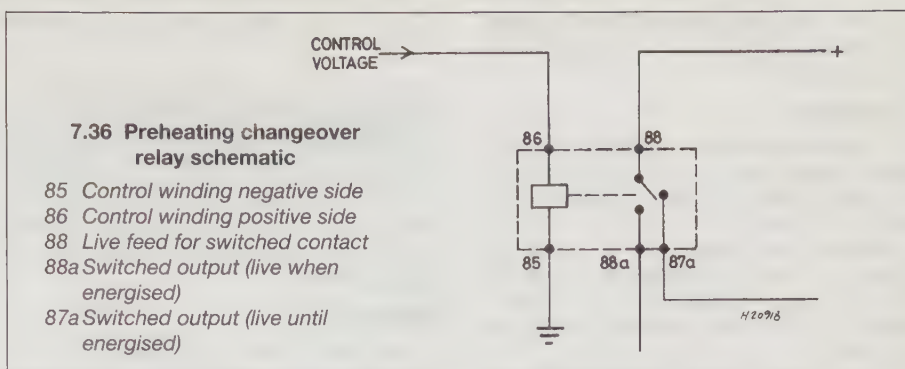
Flame plug checks

39 The following procedure applies to the Ford Transit 2.5 DI, and is a typical example of flame plug checking procedures. Refer to the manufacturer's information for specific details.

40 Bridge the system test connector. Have an assistant switch on the ignition (see illustration). The pre-heating warning lamp should illuminate for approximately 5 seconds, and then go out. While the light is lit, and for up to 20 seconds after it goes out, the flame plug should operate. Confirm this by



8.1 Feed wire connected to glow plug terminals



7.40 Flame plug test connector (C) and bridge wire (D)

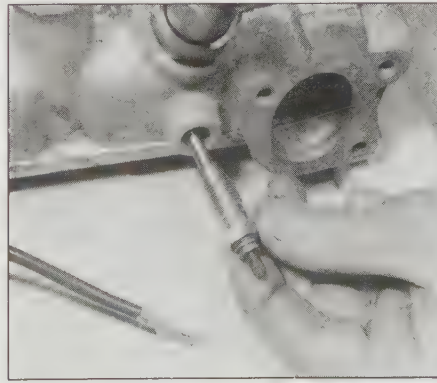
carefully feeling for heat around the plug. Switch off the ignition.

Caution: The plug will get very hot.

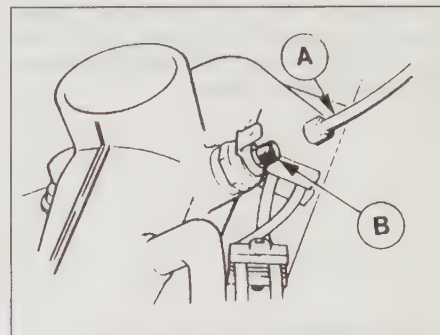
41 If the system does not operate, disconnect the fuel pipe from the flame plug, and place the end of the pipe in a small container (see illustration). Disconnect the electrical connector from the flame plug. Connect a 12-volt test lamp between the electrical feed and earth.

42 Switch on the ignition again. The voltmeter should read battery voltage, or the test lamp light, while the warning light is on, and for up to 20 seconds after it has gone out. While voltage is present, fuel should flow from the pipe.

43 If no voltage is present at the flame plug electrical feed, there is a fault in the wiring or the control unit. If voltage is present, but fuel



8.3 Removing a glow plug



7.41 Fuel pipe (A) disconnected from flame plug (B)

does not flow even through the reservoir is full, there is a fault in the wiring to the solenoid valve, or in the valve itself.

44 If voltage and fuel are both present, but the flame plug does not operate, remove the plug and apply 12 volts to its electrical terminal. Earth the body of the plug. The heating element inside the plug should be seen to glow red. If the element does not glow, renew the plug.

Caution: The plug will get very hot.

8 Glow plugs – removal and refitting

Note: This is general procedure. Refer to manufacturer's information or to the relevant Haynes *Service and Repair Manual* for specific details.



Warning: If the glow plugs have just been tested in the engine, or if the engine has just been running, they may be very hot.

Removal

1 Make sure that the ignition is switched off, then disconnect the current feed wire or strap from the glow plug terminals (see illustration). Recover any terminal nut washers.

2 Brush or blow away any debris from around the glow plug seats.

3 Unscrew the glow plugs from the cylinder head (see illustration). Recover the sealing washers (if used); new washers should be used on reassembly.

4 If the glow plugs are not to be refitted immediately, plug or cover the openings in the cylinder head.

Refitting

5 Commence refitting by applying a smear of copper-based anti-seize compound to the threads of each glow plug. Fit the sealing washers, if used.

6 Remove any plugs used to close the openings in the cylinder head, and check that the glow plug seats are clean. (This is particularly important if sealing washers are not used.)

7 Insert the glow plugs into their holes, and tighten them to the specified torque, if known. Beware of overtightening, which can damage the glow plug by reducing the gap between the element and its surround.

8 Reconnect and secure the current feed wire or strap.

9 Flame plug – removal and refitting

Note: *This procedure is intended as a general guide. Refer to manufacturer's information for specific details.*

Removal

1 Disconnect the battery negative lead.

2 Disconnect the electrical feed from the flame plug.

3 Clean around the fuel feed union, and disconnect it from the flame plug; be prepared for fuel spillage. Plug or cap the open unions.

4 Clean any debris from around the flame plug seat, and unscrew the flame plug from the inlet manifold. Recover the sealing washer (if used); a new washer should be used on refitting.

5 If the flame plug is not to be refitted immediately, plug the hole in the inlet manifold.

Refitting

6 Commence refitting by applying a smear of copper-based anti-seize compound to the threads of the flame plug. Fit the sealing washer, if used.

7 Where applicable, remove the plug from the hole in the inlet manifold, then insert the flame plug and tighten it.

8 Reconnect the fuel feed union, and the electrical feed.

9 Reconnect the battery negative lead.

Chapter 4

Ancillary components

Contents

Introduction	1	Turbochargers	3
Vacuum pumps	2	Description	
Description		Precautions	
Maintenance		Testing	
Testing		Removal and refitting	
Removal and refitting		Inspection and overhaul	
Overhaul		Aftermarket fitting	

1 Introduction

Besides the usual ancillaries found on vehicle engines, such as starter motors, alternators, power steering pumps, etc, there are two additional components which are very common on diesel engines; the vacuum pump, and the turbocharger.

Most light diesel engine vehicles rely on an engine-driven pump for brake vacuum servo operation, since there is insufficient depression created in a diesel engine's unthrottled inlet manifold to operate a servo. A few manufacturers also use vacuum to actuate items such as the injection pump stop control.

The turbocharger increases engine efficiency by raising the pressure in the inlet manifold above atmospheric pressure. Instead of the air supply simply being sucked into the cylinders, it is forced in. Additional air in the cylinders means that more fuel can be burnt and more power produced.

2 Vacuum pumps

Description

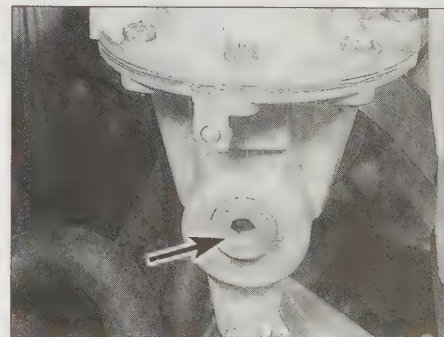
1 Vacuum pumps are usually rotary vane or diaphragm types. A reservoir may be fitted between the pump and the servo to provide enough vacuum for several applications of the brake with the engine stopped. On some commercial vehicles, loss of vacuum may be detected by a switch which controls a warning light or buzzer.

2 Pump drive may be by pulley and belt, by direct or indirect drive from the camshaft or an auxiliary shaft, or from some other ancillary component such as the alternator.

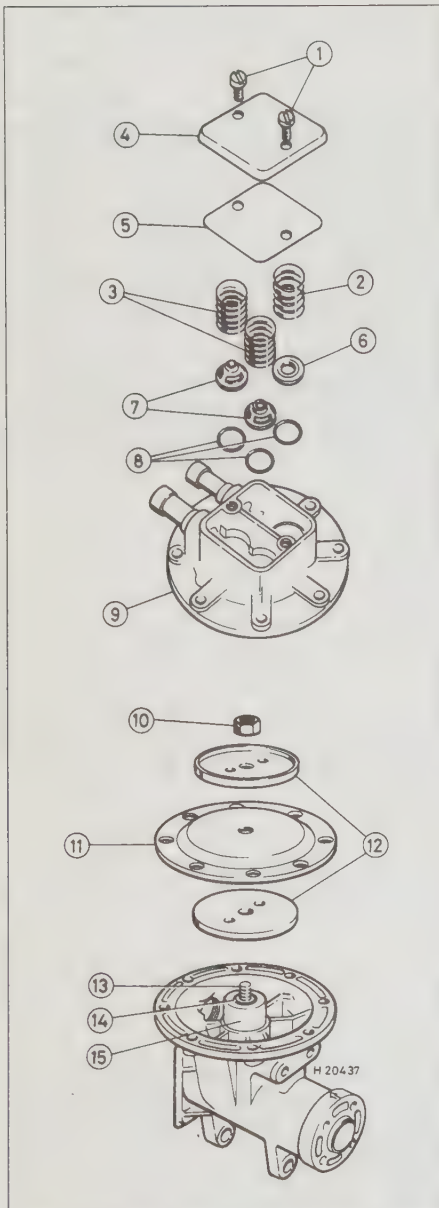
Maintenance

3 On belt-driven pumps, the tension and condition of the pump drivebelt should be checked periodically. Adjustment is carried out by pivoting the pump (or sometimes an idler pulley, or some other belt-driven component) on its mountings.

4 When an oil filler/level plug is fitted, this should be removed periodically to verify that oil is up to the level of the plug hole (**see illustration**). (On some types of pump, the pulley must be turned to align a mark on the pulley shoulder with a mark on the pump before checking the level.) Top up if necessary with the specified oil, and refit the level plug.



2.4 Vacuum pump oil filler/level plug (arrowed)



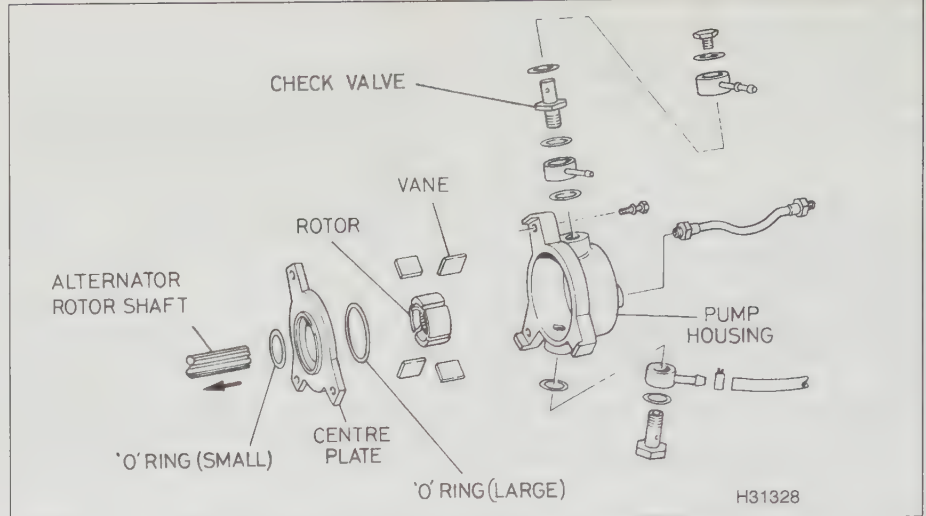
2.13 Exploded view of a diaphragm type vacuum pump

- | | |
|------------------------|-------------------|
| 1 Cover screws | 8 Seals |
| 2 Inlet valve spring | 9 Diaphragm cover |
| 3 Outlet valve springs | 10 Nut |
| 4 Cover | 11 Diaphragm |
| 5 Gasket | 12 Support plates |
| 6 Inlet valve | 13 Screw |
| 7 Outlet valves | 14 O-ring |
| | 15 Piston |

Testing

5 Disconnect the pump-to-servo (or reservoir) hose. Connect a vacuum gauge to the pump inlet port.

6 Start the engine, and allow it to idle; note the rate at which the vacuum increases. Hard-and-fast values are not often specified, but as a guide, the pump should produce a vacuum of at least 0.67 bar (500 mm Hg) within one minute. If



2.21 Exploded view of a vane type vacuum pump

it does not, either the drivebelt is slipping (when applicable), or the pump is faulty.

Removal and refitting

7 Removal is generally straightforward, and is typically carried out as follows.

8 Disconnect the hose(s) from the pump, noting which is inlet and which (if any) is exhaust. If separate oil feed and return hoses are fitted, disconnect them too, being prepared for oil spillage.

9 If the pump is belt-driven, slacken the pump mountings and remove the drivebelt.

10 Remove the pump mounting nuts and bolts, and remove the pump. Recover any seals or gaskets. In the case of a cam-operated pump, recover the operating plunger or pushrod if it is loose.

11 Refitting is the reverse of the removal procedure. Renew any seals or gaskets if necessary, and on belt-driven pumps, adjust the drivebelt tension.

Overhaul

12 Most modern pumps are sealed units, and no spare parts are available. If spares are available, the following procedures can be used for guidance.

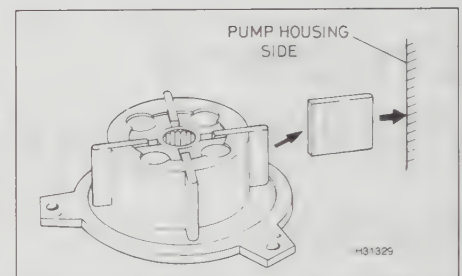
Diaphragm type pump

13 Remove the screws which secure the valve cover. Lift off the cover and gasket, followed by the springs, valves and seals (see illustration).

14 Mark the diaphragm cover in relation to the body of the pump. Remove the screws which secure the cover, and lift off the cover. Remove the central nut or screw, and remove the diaphragm and support plates from the piston. Recover the O-ring, if fitted, from the recess in the top of the piston.

15 Turn the pulley to bring the pump piston to the top of its stroke. In this position, check for wear by trying to move the piston from side to side. If excessive wear is present, renew the pump.

16 Clean all components. Commence



2.22 Correct fitting of vanes in rotor – vane type vacuum pump

reassembly by fitting a new O-ring, if applicable, to the top of the piston.

17 Fit a new diaphragm and the support plates to the piston, making sure that the support plates are the right way round. Apply thread-locking fluid to the threads of the central nut or screw, then fit and tighten it.

18 Refit and secure the diaphragm cover, observing the previously-made alignment marks.

19 Fit new seals, valves and springs into the valve chest. Fit a new gasket, then refit and secure the cover.

20 Top up the pump oil level before refitting.

Rotary vane type pump

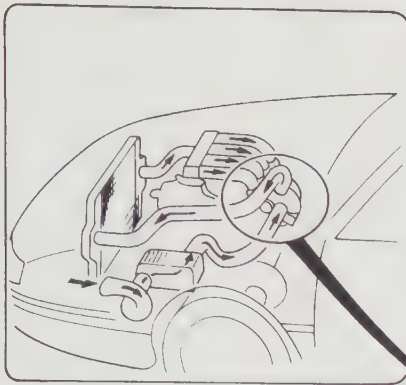
21 Remove the check valve and the oil feed and return pipe unions from the pump (see illustration).

22 Separate the centre plate from the pump housing. Remove the rotor and vanes, noting which way round the vanes are fitted (see illustration).

23 Renew the O-rings, sealing washers, etc, as a matter of course. Renew the vanes if they are worn or damaged. If the rotor or the pump housing is worn, a complete new pump will probably be needed.

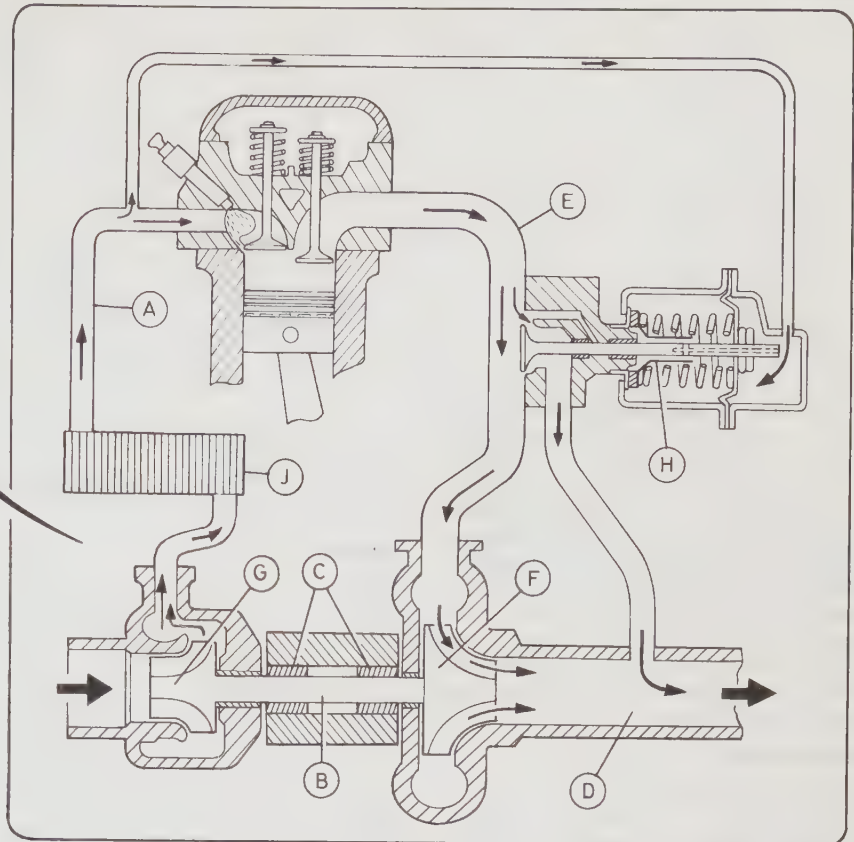
24 Test the check valve with low air pressure applied to each side. It should only pass air in one direction.

25 Reassemble the pump, coating the various parts with clean engine oil.



- A Inlet manifold
- B Turbine shaft
- C Bearings
- D Exhaust downpipe
- E Exhaust manifold
- F Turbine wheel
- G Compressor wheel
- H Wastegate actuator
- J Intercooler

H31330



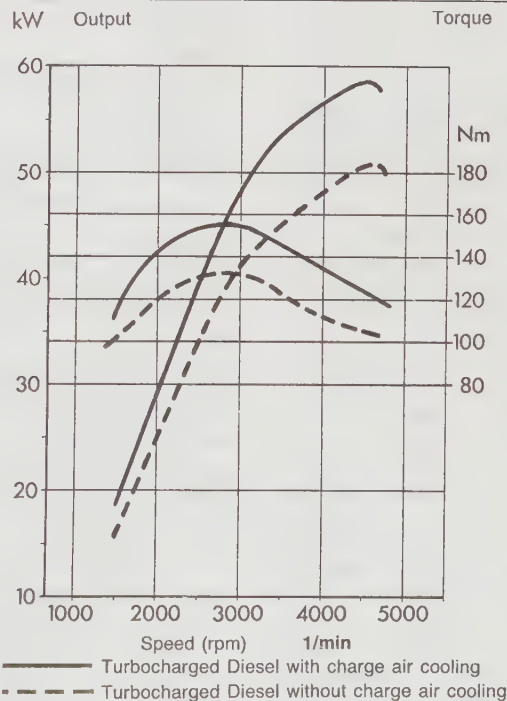
3.1 Turbocharger location and schematic view of operation – Citroën XM

3 Turbochargers

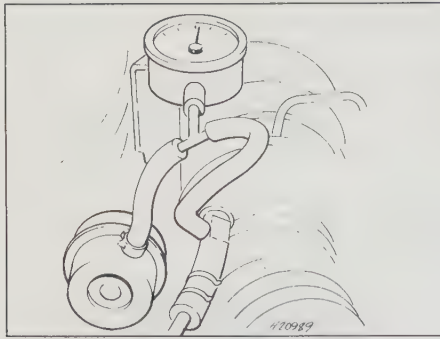
Description

1 Energy for the operation of the turbocharger comes from the exhaust gas. The gas flows through a specially-shaped housing (the *turbine housing*), and in so doing spins the turbine wheel. The turbine wheel is attached to a shaft, at the end of which is another vaned wheel known as the *compressor wheel*. The compressor wheel spins in its own housing, and compresses the inducted air on the way to the inlet manifold (see illustration).

2 On some models, the compressed air passes through an *intercooler* before arriving at the manifold. The intercooler is an air-to-air heat exchanger, which removes from the inducted air some of the heat it gained in being compressed. Under full-load conditions, the temperature of air leaving the turbocharger can be over 100°C (212°F). The intercooler in these conditions reduces the temperature by about 50°C. Cooling the air makes it denser and increases engine efficiency (see illustration).



3.2 Engine power and torque with and without charge air cooling (intercooling)



3.13 Turbo-boost pressure check

3 Boost pressure (the pressure in the inlet manifold) is limited by a wastegate, which diverts the exhaust gas away from the turbine wheel in response to a pressure-sensitive actuator. A blow-off or dump valve is often fitted in the inlet manifold, as secondary protection against excessive boost pressure.

4 The turbine shaft is pressure-lubricated by a feed from the main oil gallery. When the engine is running, the shaft 'floats' on a cushion of oil. A drain pipe returns the oil to the sump. Some models also circulate coolant round the turbo housing.

Precautions

5 The turbocharger operates at extremely high speeds and temperatures. Certain precautions must be observed to avoid premature failure of the turbo, or injury to the operator.

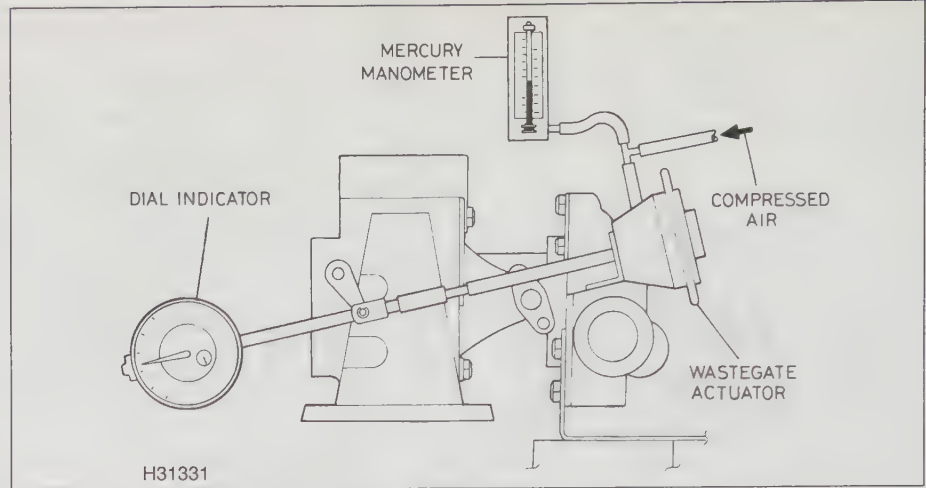
6 Do not operate the turbo with any parts exposed. Foreign objects falling onto the rotating vanes could cause damage and (if ejected) injury. Loose rags, small tools or other objects could also be drawn into the turbo air intake when the engine is running.

7 Do not run the engine without an air cleaner element fitted. Even if no large foreign objects pass through and damage the turbo, dust and grit in the air can damage the turbo at operating speeds.

8 Do not race the engine immediately after start-up, especially if it is cold. Give the oil a few seconds to circulate. This is particularly important after an oil change. If the turbo oil feed has drained, it is advisable to prime it by cranking the engine on the starter motor (with the pump stop solenoid disconnected, or the stop lever actuated) until the oil pressure warning light goes out.

9 Do not switch off the engine before it has returned to idle speed. After a high-speed run, allow the engine to idle for a minute or so before switching off. Do not blip the throttle and then stop the engine, as this will leave the turbo spinning without lubrication.

10 Observe the specified intervals for oil and filter changing, and use a reputable oil of the specified quality. Neglect of oil changing, or use of inferior oil, can cause the formation of carbon on the turbine shaft, leading to premature failure.



3.21 Wastegate actuator operation check

Testing

11 As a quick check of turbo function, open the bonnet and run the engine, accelerating it briskly. It should be possible to hear the turbocharger whistling or whining.

12 For accurate checking of boost pressure, a pressure gauge (range approximately 0 to 2 bar) will be needed, positioned so that it can be viewed when driving.

13 Connect the gauge into a suitable hose which conveys inlet manifold pressure – for instance, the hose which supplies this pressure to the injection pump (see illustration).

14 Drive the vehicle, and briefly create the maximum possible boost by applying both brake and throttle at approximately 3000 rpm in 3rd gear. Note the boost pressure developed.

Caution: Do not allow boost pressure to reach levels in excess of those specified by the manufacturer.

Typical figures are:

Maximum working boost	Warning light/dump valve operates at
0.7 to 1.0 bar	0.9 to 1.2 bar

15 Low boost pressure is not necessarily due to a fault in the turbocharger – see Chapter 9. Excessive boost pressure can only be due to a fault associated with the wastegate actuator.

Removal and refitting

16 Removal involves disconnection of the induction and boost air pipes and hoses, the exhaust front section, and the oil feed and return pipes. Additionally, some turbochargers have coolant feed and return pipes which must be disconnected.

17 Once the various pipes and hoses have been disconnected, the turbocharger can be unbolted from the exhaust manifold, or (if access dictates) removed with the manifold and separated on the bench. Lockplates are frequently used on the turbo-to-manifold fastenings, and these must be renewed.

18 Refit by reversing the removal operations,

using new oil seals, gaskets, etc. Initially prime the turbo lubrication circuit by injecting clean engine oil into the turbocharger and/or oil feed pipe. Carry out further priming before start-up, by cranking the engine with the stop solenoid disconnected.

Inspection and overhaul

19 Inspect the turbine and compressor wheel vanes for cracks and chips. Spin them to verify that the shaft is intact, and check for shake or roughness. Some free-play is normal; this is taken up in use by the pressurised oil feed. Typical values are:

Axial (end-to-end) play	Radial (side-to-side) play
0.005 to 0.10 mm	0.30 to 0.60 mm

20 If turbine shaft oil seal failure has occurred, this will be evident by heavy deposits of oil or carbon. The induction passages and intercooler may also be contaminated; if this has happened, the intercooler should be flushed out.

21 Check the operation of the wastegate actuator by applying low air pressure (typically up to 1 bar) to it. The actuator rod must move in and out smoothly when pressure is applied and released. Vehicle manufacturers often specify travel for the wastegate actuator lever under given pressures; in this case, a pressure gauge and a dial test indicator (DTI) may be required for testing (see illustration).

22 No overhaul of the turbocharger is generally possible, although it may be possible to renew the wastegate actuator separately. The old unit may be accepted in part exchange for a new or reconditioned one.

Aftermarket fitting

23 Various specialist firms offer aftermarket fitting of turbochargers. To have any useful effect, such fitting must include recalibration or renewal of the fuel injection pump. Such work will probably invalidate any manufacturer's warranty on the engine and fuel injection system; reputable firms may take on this warranty risk themselves.

Chapter 5

Emission control

Contents

Introduction	1	Exhaust emissions control systems	3
Crankcase emissions control systems	2	Catalytic converter	
		Particle filters	
		Exhaust gas recirculation system	4

1 Introduction

Legislation exists in most developed countries to reduce vehicle emissions (both diesel and petrol) in order to protect the population's health, and the environment. The permitted levels of pollution are being progressively reduced as time goes on, and vehicle manufacturers are required to invest heavily to improve engine efficiency and reduce harmful emissions.

All modern diesel engines are equipped with features designed to reduce the emissions of harmful by-products of the combustion process into the atmosphere.

When diesel fuel is burnt, a variety of combustion products are formed. The products formed depend on the fuel quality, engine design, the power output, and the working load on the engine. The major by-products of the combustion process are water (H_2O) and carbon dioxide (CO_2 - a 'greenhouse' gas, although not toxic).

Besides these two main products, the following substances are also produced in relatively low concentrations:

Carbon monoxide (CO).

Unburnt hydrocarbons (HC).

Nitrogen oxides (NOx).

Sulphur dioxide (SO_2) and sulphuric acid (H_2SO_4).

Soot (carbon) particles.

Complete combustion of the fuel leads to major reductions in the formation of toxic substances, and so one of the most important design parameters for a modern diesel engine is to achieve near-complete combustion under all engine operating conditions.

The following engine and fuel system features help to reduce exhaust gas emissions, and have the added benefit of improving fuel consumption:

Accurate start of injection timing.

Precision-manufactured injection nozzles.

Precise fuel metering.

Precisely-defined fuel-spray geometry.

High injection pressures.

Combustion chamber design.

As an example of the importance of accurate

control of the injection process, a deviation of the start of injection by 1° of crankshaft rotation can cause increases in NOx and CO emissions of 5% and 15% respectively.

Diesel fuel contains sulphur, which as mentioned previously, is converted into sulphur dioxide and sulphuric acid during combustion. To reduce the levels of these harmful by-products, the permitted sulphur content in diesel fuel has been reduced in stages over recent years, and according to current standards must not exceed 0.2% by weight. This level is likely to be reduced further in the future.

Although the measures mentioned previously reduce harmful emissions significantly, additional devices and systems can be used to reduce emissions even further. The most-commonly used systems on modern diesel engines are:

Crankcase emissions control system.

Exhaust emissions control system (catalytic converter and/or soot burn-off filter).

Exhaust gas recirculation system.

These systems are described in the following Sections.

2 Crankcase emissions control systems

1 To reduce the emission of unburned hydrocarbons from the engine crankcase into the atmosphere, the engine is sealed. Piston blow-by gases (combustion gases which have passed by the piston rings) and oil vapour are drawn from the crankcase and the cylinder head cover, through an oil separator, into the inlet tract (**see illustration**). The gases are then drawn into the engine, together with fresh air/fuel mixture, to be burned by the engine during normal combustion. Condensed oil vapour is returned from the oil separator to the engine sump.

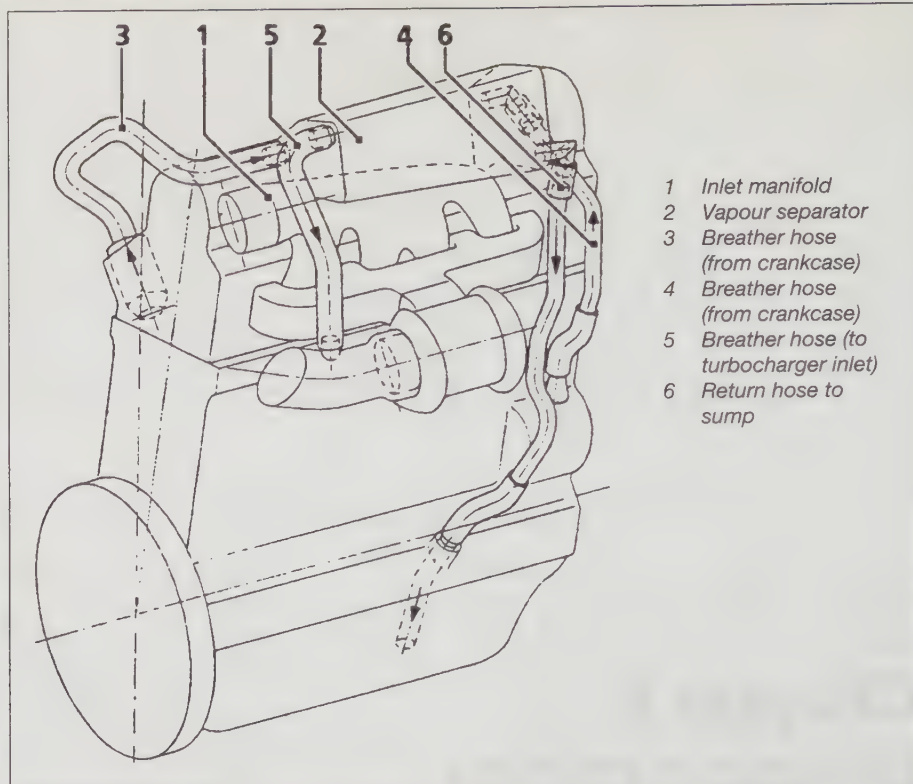
3 Exhaust emissions control systems

Catalytic converter

1 To minimise the level of exhaust gas pollutants released into the atmosphere, a catalytic converter is fitted, located in the exhaust system.

2 The catalytic converter consists of a canister containing a fine mesh impregnated with a catalyst material, over which the exhaust gases pass. The catalyst speeds up the oxidation of harmful carbon monoxide and unburnt hydrocarbons, effectively reducing the quantity of harmful products reaching the atmosphere (**see illustration**). As unburnt hydrocarbons contribute to particle emission, this can also be reduced to a limited extent by a catalytic converter.

3 A closed-loop catalytic converter system using an oxygen sensor, similar to that used on petrol engines, cannot be used on a diesel engine because a diesel engine always operates with excess air, and hence oxygen, in the exhaust gas.



2.1 Typical crankcase emission control system

Particle filters

4 Particle filters are designed to reduce the level of smoke particles released into the atmosphere from a diesel engine exhaust. These devices are in the early stages of development, and various alternative systems are used by different manufacturers.

5 Particle filters work by filtering out the tiny soot particles (carbon particles coated with unburnt hydrocarbons, lubricating oil, sulphates and water) before they reach the exhaust tailpipe. Such filters are usually located in the exhaust system in the position normally occupied by a catalytic converter.

Particle filters are often combined with a catalytic converter in a single unit.

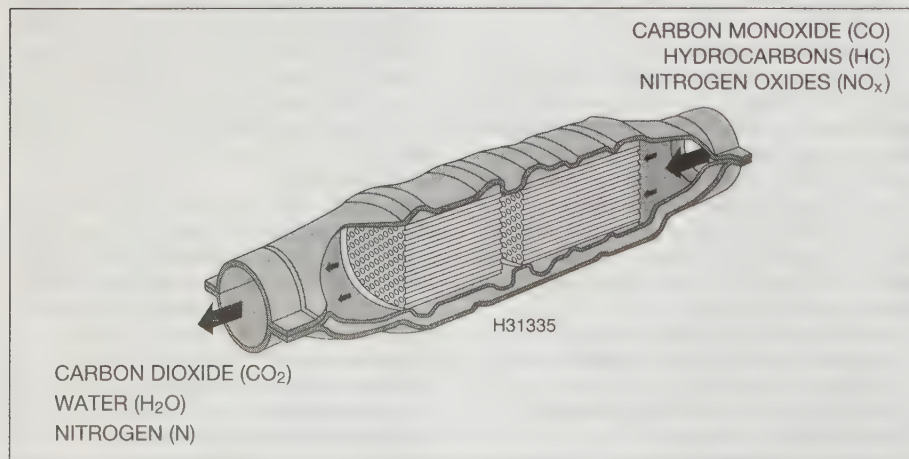
6 At the time of writing, the two most commonly used types of particle filter are the soot burn-off filter and the plasma particle filter. The two types of filter are described briefly in the following paragraphs.

Soot burn-off filter

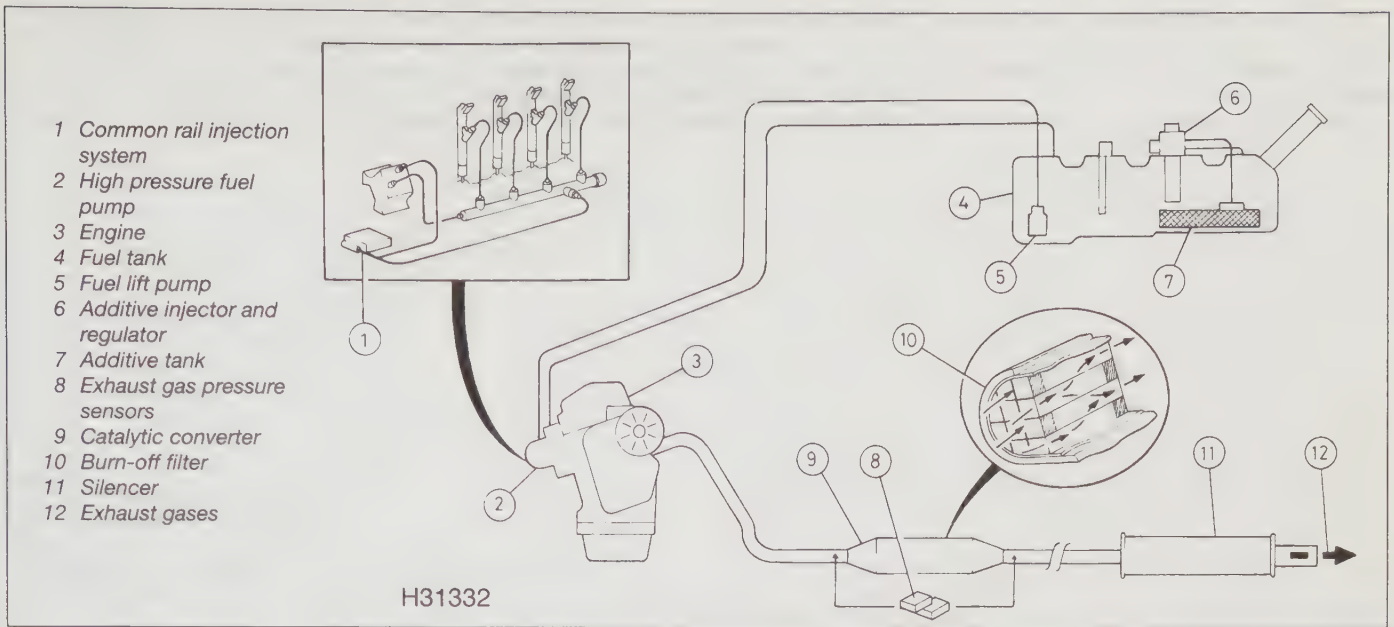
7 Several different types of soot burn-off filter have been developed, but the following paragraphs describe a typical filter system being developed for fitment to some Peugeot/Citroën models (**see illustration**).

8 In a soot burn off filter, the soot particles are trapped in a block of filter material, usually silicon carbide. The filter has to be carefully designed to allow the exhaust gases to flow through it, whilst trapping the soot particles; however there obviously comes a point when the filter will become blocked due to the large number of particles trapped (after, say, 200 to 300 miles of driving). As the trapped particles in the filter build up, there will be a resistance to the exhaust gas flow, and the filter must be cleaned to prevent a build-up of exhaust back-pressure.

9 Because the diesel engine always operates with excess air, the exhaust gas contains enough oxygen that at temperatures above approximately 550°C, soot will burn off of its own accord. The exhaust gas temperature in a diesel engine is normally between 150°C and 200°C, which is not high enough to burn



3.2 Cross-section of a typical catalytic converter



3.7 Schematic view of emission control system using soot burn-off filter

off soot. The exhaust gas temperature can be raised by injecting extra fuel and air. Additionally, the reaction in a catalytic converter will raise the exhaust gas temperature, so soot burn-off filters are often combined with catalytic converters in a single unit.

10 Even with the extra temperature provided by additional fuel/air and the catalytic converter reaction, additional heat is still

required to burn the soot. This is provided by the injection of an additive into the diesel fuel. Injection of the additive is controlled by the electronic diesel control ECU. An exhaust gas pressure sensor (or sensors) in the exhaust system provide the ECU with information which allows it to calculate when the filter is becoming blocked. When the exhaust gas pressure falls to a predetermined level, a 'shot' of additive is injected into the fuel,

which raises the temperature inside the filter, and burns off the soot, cleaning the filter in the process. The additive is usually contained in a separate tank on the vehicle.

Plasma particle filter

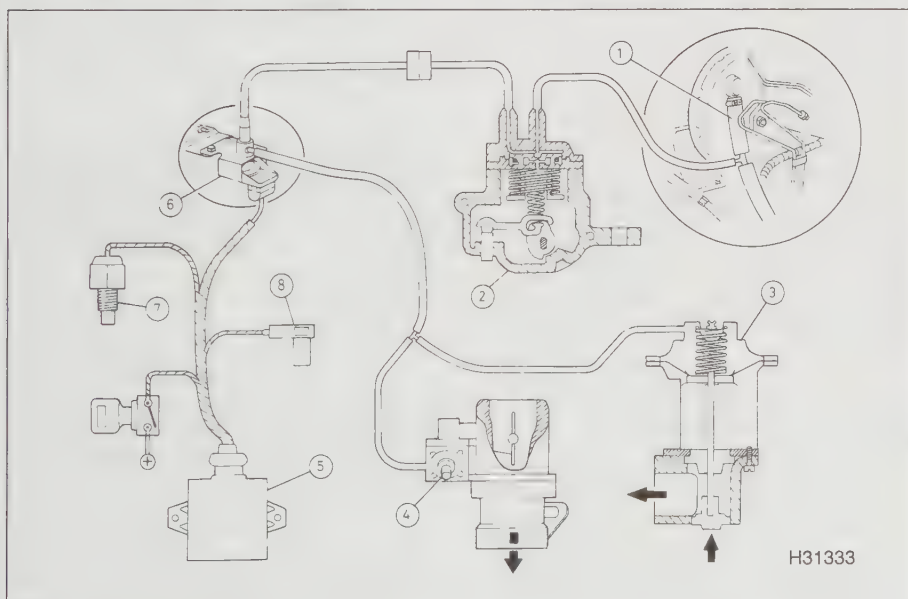
11 This type of filter is in the early stages of development, and is designed to reduce both particle and NO_x emissions. The filter contains a filter material which has a dielectric compound embedded in it. A high-voltage feed creates a plasma within the filter. Particles adhering to the filter are exposed to the plasma which causes partial oxidation of the soot particles and NO_x compounds. A remote or integral catalytic converter enables further oxidation before the exhaust gases are released into the atmosphere.

4 Exhaust gas recirculation system

1 An exhaust gas recirculation (EGR) system is designed to recirculate small quantities of exhaust gas into the inlet tract, and therefore into the combustion process. This process reduces the level of oxides of nitrogen present in the final exhaust gas which is released into the atmosphere, and also lowers the combustion temperature.

2 The volume of exhaust gas recirculated is controlled by vacuum, via a solenoid valve. The solenoid valve is controlled by a fuel injection pump-mounted sensor on models with a conventional injection pump, or by the electronic diesel engine control unit (ECU) on models with an electronically-controlled injection system (see illustration).

3 A vacuum-operated recirculation valve is



4.2 Schematic view of a typical exhaust gas recirculation system

- | | | |
|--|---|------------------------------------|
| 1 Brake servo vacuum hose | 4 Flow valve/butterfly housing (fitted to inlet manifold) | 7 Coolant temperature sensor |
| 2 Vacuum converter (fitted to fuel injection pump) | 5 Electronic control unit | 8 Crankshaft speed/position sensor |
| 3 Recirculation valve (fitted to exhaust manifold) | 6 Solenoid valve | |

5•4 Emission control

fitted to the exhaust manifold, to regulate the quantity of exhaust gas recirculated. The valve is operated by the vacuum supplied via the solenoid valve.

4 Between idle speed and a pre-determined

engine load, power is supplied to the solenoid valve, which allows the recirculation valve to open. Under full-load conditions, the exhaust gas recirculation is cut off. On most EGR systems, additional control is provided by the

engine temperature sensor, which cuts off the vacuum supply until the engine coolant temperature reaches a pre-determined level, preventing the recirculation valve from opening during the engine warm-up phase.

Chapter 6

Tools and equipment

Contents

Normal workshop tools	1	Injection pump timing tools	3
Socket and spanner sizes		Static timing tools	
Angle-tightening		Dynamic timing tools	
Splined and 'Torx' bolt heads		Injector testing equipment	4
Diesel-specific tools	2	Injection pump testing and calibration equipment	5
Basic tune-up and service		Smoke testing equipment	6
Injector socket		Electronic fault code readers	7
Injector puller			
Tachometer			
Electrical multi-meter or glow plug tester			
Compression tester			
Leak-down tester			
Vacuum pump and/or gauge			

1 Normal workshop tools

1 The decision as to what range of tools is necessary will depend on the work to be done, the range of vehicles which it is expected to encounter, and (not least) the financial resources available. The tools in the following list, with additions as necessary from the various categories of diesel-specific tools described later, should be sufficient for carrying out most routine maintenance and repair operations.

Combination spanners (see text)

Socket spanners (see text)

Ratchet, extension piece and universal joint (for use with sockets)

Torque wrench

Angle-tightening indicator (see text)

Adjustable spanner

Set of sump drain plug keys

Strap or chain wrench (for fuel and oil filters)

Oil drain tray

Feeler gauges

Pliers

Long-nosed pliers

Self-locking pliers ('Mole' wrench)

Screwdrivers (large and small, flat blade and cross-blade)

Set of Allen keys

Set of splined and 'Torx' keys and sockets (see text)

Ball pein hammer

Soft-faced hammer

Puller (universal type with interchangeable jaws)

Cold chisel

Scriber

Scraper

Centre-punch

Hacksaw

File

Steel straight-edge

Axle stands and/or ramps

Trolley jack

Inspection light

Inspection mirror

Telescopic magnet/pick-up tool

Socket and spanner sizes

2 A good range of open-ended and ring spanners will be required. Most modern vehicles use metric size fastenings throughout, but some early UK-built vehicles may have Imperial fastenings – or a mixture of both.

3 Split ring spanners (also known as flare nut spanners) are particularly useful for dealing with fuel pipe unions, on which a conventional ring spanner or socket cannot be used because the pipe is in the way. The most common fuel union sizes are 17 mm and 19 mm on metric systems, and 5/8 in and 3/4 in on Imperial systems.

4 Sockets are available in various drive sizes. The half-inch square drive size is most widely used, and can be used with most torque wrenches. The 3/8 in square drive is also useful for lower torque applications, especially in confined spaces, and 1/4 in and 3/4 in drive tools are also available.

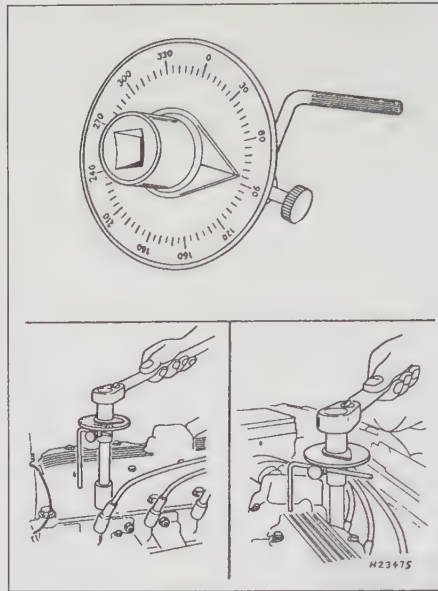
5 Box spanners should not be overlooked. Box spanners are cheap, and will sometimes serve as a substitute for a deep socket,

though they cannot be used with a torque wrench, and are easily deformed.

Angle-tightening

6 For fastenings such as cylinder head bolts, many manufacturers specify tightening in terms of angular rotation rather than an absolute torque. After an initial 'pre-tightening' torque wrench setting, subsequent tightening stages are specified as angles through which each bolt must be turned. Variations in tightening torque which could be caused by the presence or absence of dirt, oil, etc., on the bolt threads are eliminated. A further benefit is that there is no need for a high-range torque wrench.

7 The owner/mechanic who expects to use this method of tightening only once or twice in the life of the vehicle may be content to make up a cardboard template or mark the bolt heads with paint spots, to indicate the angle required. Greater speed and accuracy will result from using one of the many angle-tightening indicators commercially available (see illustration).



1.7 Typical angle-tightening indicator

Splined and 'Torx' bolt heads

8 The conventional hexagon head bolt is being replaced in many areas by the 'splined' or 'Torx' head bolt. This type of bolt has multiple splines in place of the hexagon: splined bolts generally have 12 splines, and Torx bolts have six splines. A set of splined or Torx keys will be needed to deal with female fixings. Torx bolts with male heads also exist, and for these Torx sockets will be needed.

2 Diesel-specific tools

Basic tune-up and service

1 Besides the normal range of spanners, screwdrivers and so on, the following tools and equipment will be needed for basic tune-up and service operations on most models:

Deep socket for removing and tightening screw-in injectors

Injector puller for removing clamp-type injectors

Optical or pulse-sensitive tachometer

Electrical multimeter, or dedicated glow plug tester

Compression or leakdown tester

Vacuum pump and/or gauge

Injector socket

2 The size most commonly required is 27 mm AF; some Japanese injectors require 22 mm AF. The socket needs to be deep in order not to foul the injector body, and on some engines it also needs to be thin-walled.

Injector puller

3 This consists of a small slide hammer, with a range of adapters to screw into the various

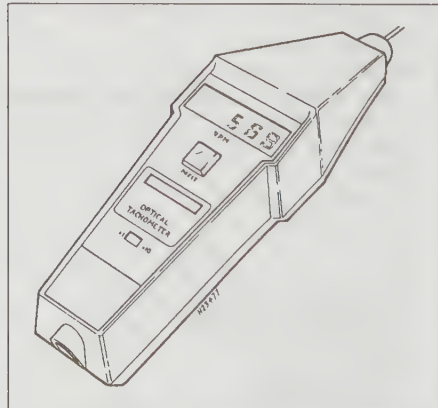
end fittings which will be encountered (see illustration). Once secured, the slide hammer is used to draw the injector out of its bore in the cylinder head, in which it may be a very tight fit.

Tachometer

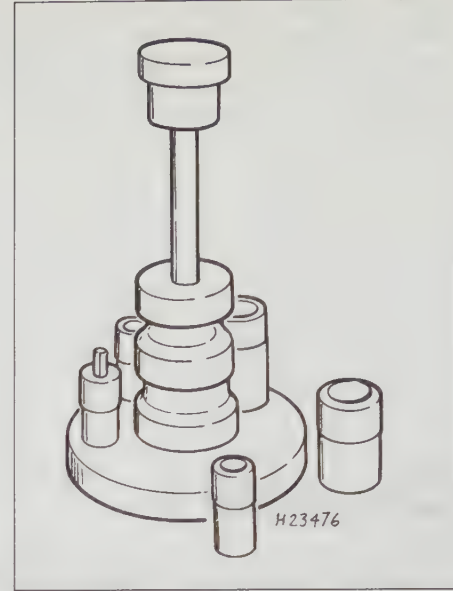
4 The type of tachometer which senses ignition system HT pulses via an inductive pick-up cannot be used on diesel engines, unless a suitable timing light adapter is available. If the engine is fitted with a TDC sensor and a diagnostic socket, an electronic tachometer which reads the signals from the TDC sensor can be used.

5 Not all engines have TDC sensors; on those which do not, the use of an optical or pulse-sensitive tachometer is necessary.

6 The optical tachometer registers the passage of a paint mark or (more usually) a strip of reflective foil placed on the crankshaft pulley. It is not so convenient to use as the electronic or pulse-sensitive types, since it has to be held so that it can 'see' the pulley,



2.6 Typical optical tachometer



2.3 Typical injector puller set

but it has the advantage that it can be used on any engine, petrol or diesel, with or without a diagnostic socket (see illustration).

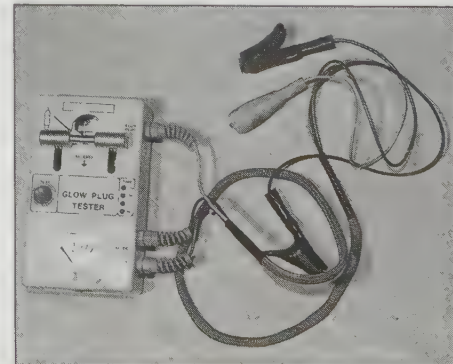
7 The pulse-sensitive tachometer uses a transducer similar to that needed for a timing light. The transducer converts hydraulic or mechanical impulses in an injector pipe into electrical signals, which are displayed on the tachometer as engine speed.

8 Some dynamic timing equipment for diesel engines incorporates a means of displaying engine speed. If this equipment is available, a separate tachometer will not be required.

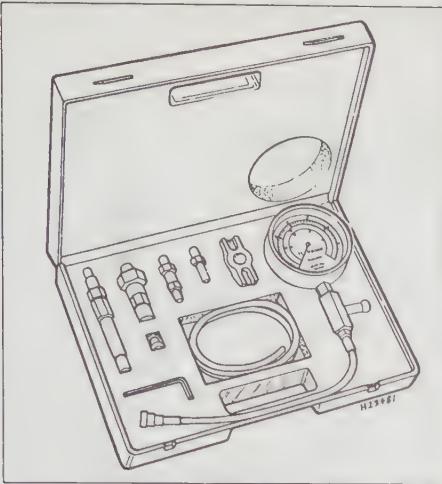
Electrical multimeter or glow plug tester

9 It is possible to test glow plugs and their control circuitry with a multimeter, or even (to a limited extent) with a 12-volt test lamp. A purpose-made glow plug tester will do the job faster, and is much easier to use (see illustration).

10 If it is decided to purchase a multimeter, make sure that it has a high current range – ideally 0 to 100 amps – for checking glow plug



2.9 Typical glow plug tester



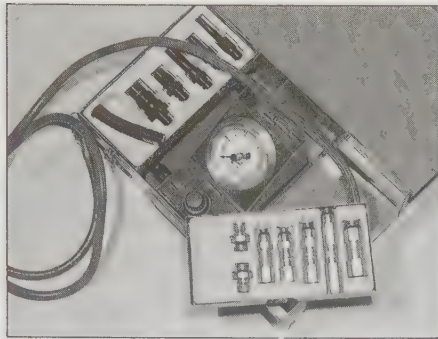
2.11 Typical diesel engine compression tester kit

current draw. Some meters require an external shunt to be fitted for this. An inductive clamp connection is preferred for high current measurement, since it can be used without breaking into the circuit. Other ranges required are dc voltage (0 to 20 or 30 volts is suitable for most applications) and resistance. Some meters have a continuity buzzer in addition to a resistance scale.

Compression tester

11 A tester specifically intended for diesel engines must be used (see illustration). The push-in connectors used with some petrol engine compression testers cannot be used for diesel engines because of the higher pressures involved. Instead, the diesel engine compression tester screws into an injector or glow plug hole, using one of the adapters supplied with the tester.

12 Most compression testers are used while cranking the engine on the starter motor. A few can be used with the engine idling; this



2.13 Typical leak-down tester kit

gives more reliable results, since it is hard to guarantee that cranking speed will not fall in the course of testing all cylinders, whereas the idle speed should remain constant.

Leak-down tester

13 The leak-down tester measures the rate at which air pressure is lost from each cylinder, and can also be used to pinpoint the source of pressure loss (valves, head gasket or bores). Its use depends on the availability of a supply of compressed air, typically at 5 to 10 bar. The same tester (with different adapters) can be used on both petrol and diesel engines (see illustration).

14 In use, the tester is connected to an air line and to an adapter screwed into the injector or glow plug hole, with the piston concerned at TDC on the compression stroke. The procedure is described in Chapter 9, Section 4.

Vacuum pump and/or gauge

15 A vacuum gauge with suitable adapters is useful for locating blockages or inlet air leaks in the supply side of the fuel system. A simple gauge is used with the engine running to create a vacuum in the supply lines. A hand-held vacuum pump with its own gauge can be

used without running the engine, and is also useful for bleeding the fuel system when a hand-priming pump is not fitted (see illustration). Test procedures are given in Chapter 9, Section 3.

3 Injection pump timing tools

1 If work is undertaken which disturbs the position of the fuel injection pump, certain tools will be required to check the injection pump timing on reassembly. This also applies if the pump drive is disturbed – including renewal of the timing belt on some models. Checking of the timing is also a necessary part of fault diagnosis when investigating complaints such as power loss, knock and smoke.

Static timing tools

2 Static timing is still the most widely-used method of setting diesel injection pump, but it is time-consuming and sometimes messy. Precision measuring instruments are often needed for dealing with distributor pumps, and good results depend on the skill and patience of the operator.

3 The owner-mechanic who will only be dealing with one engine should refer to the manufacturer's information or to the relevant Haynes Service and Repair Manual to find out what tools will be required. The diesel engine specialist will typically need the following:

Two dial test indicators (DTI) with magnetic stands.

DTI adapters and probes for Bosch and CAV distributor pumps.

Spill tube for in-line pumps.

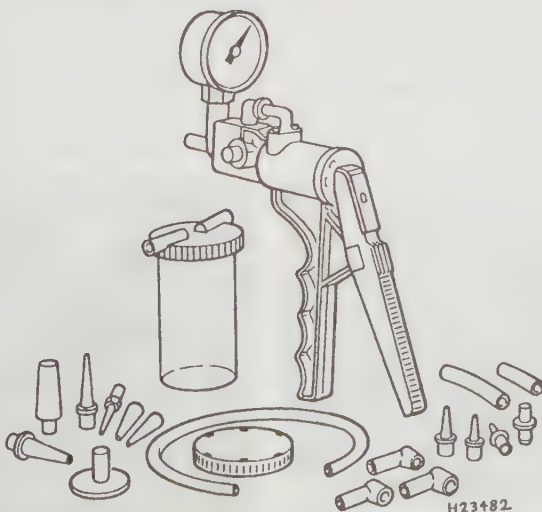
Timing gear pins and pegs.

Crankshaft or flywheel locking pins.

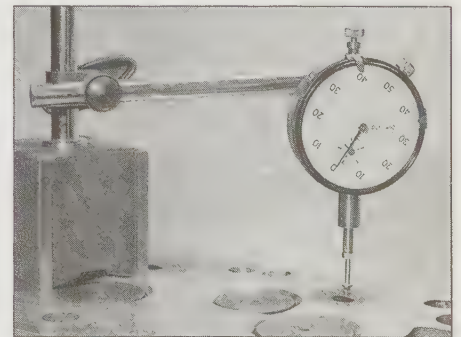
Dial test indicator and magnetic stand

4 This is a useful workshop tool for many operations besides timing: it is, for example, the most accurate means of checking the protrusion or recess of swirl chambers, pistons and liners when renewing cylinder head gaskets (see illustration). If major overhauls are undertaken, it can also be used for measuring values such as crankshaft endfloat.

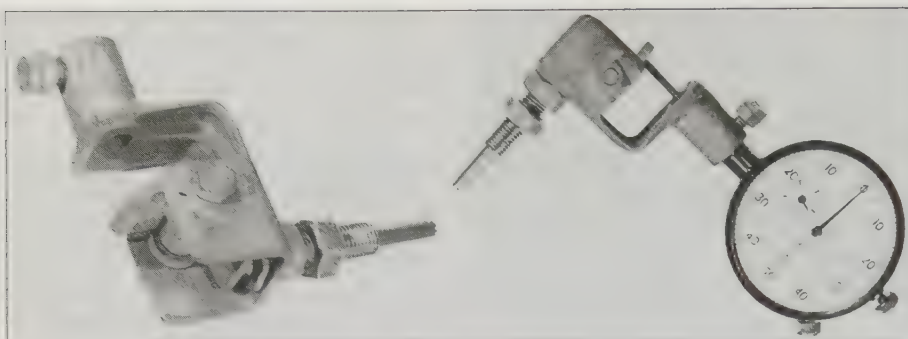
5 Two DTIs are needed for setting the timing



2.15 Typical hand-held vacuum pump with gauge



3.4 Dial test indicator and stand being used to check swirl chamber protrusion



3.6 DTI and fabricated bellcrank adapter for timing a Bosch VE pump

on some engines (for instance, the early Peugeot/Citroen XUD series): one to measure the pump plunger or rotor movement, and one to measure engine piston protrusion.

DTI adapters

6 Adapters and probes for fitting the DTI to the distributor pump are of various patterns, due partly to the need to be able to use them in conditions of poor access on the vehicle (see illustration). This means that the same adapter cannot necessarily be used on the same type of pump and engine if the under-bonnet layout is different. On the bench, it is often possible to use similar equipment.

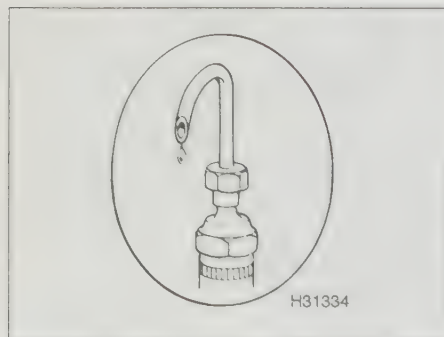
7 A spring-loaded probe is required on some CAV/RotoDiesel pumps to find the timing groove in the pump rotor (see illustration).

Spill tube

8 This is a relatively cheap and simple piece of equipment, used for timing many in-line pumps. The tube is fitted in place of one of the pump delivery valves. The traditional form of tube has a 'swan neck' shape; more modern versions have a transparent vertical tube with a calibrated line. A spill tube can easily be made in the workshop using an old injector pipe (see illustration).

Timing gear pins or pegs

9 Pins or pegs are used on some engines to lock the pump and/or the camshaft in a particular position. They are generally specific to a particular engine or manufacturer. It is sometimes possible to use suitably-sized dowel rods, drill shanks or bolts instead.



3.8 Simple spill tube

Crankshaft or flywheel locking pins

10 These are used for locking the crankshaft at TDC (or at the injection point on some models). The crankshaft locking pin is inserted through a hole in the side of the crankcase after removal of a plug, and enters a slot in a crankshaft counterweight or web. The flywheel pin passes through a hole in the flywheel end of the crankcase, and enters a hole in the flywheel. Again, suitably-sized rods or bolts can sometimes be used instead.

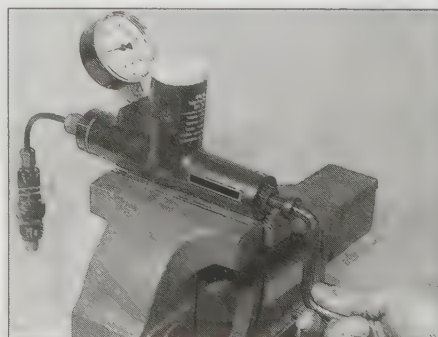
Dynamic timing tools

11 Dynamic timing on diesel engines is not as widespread as static timing, due partly to the relatively expensive equipment required. Additionally, not all vehicle manufacturers provide dynamic timing values.

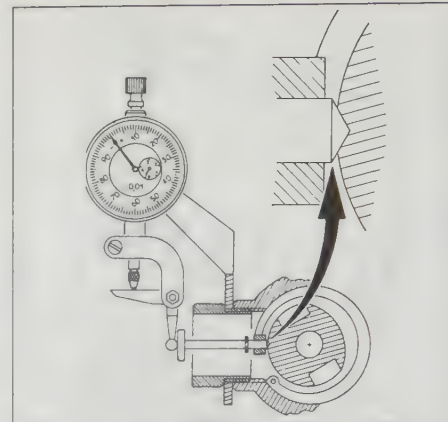
12 Most dynamic timing equipment depends on converting mechanical or hydraulic impulses in the injection system into electrical signals. An alternative approach is to use an optical-to-electrical conversion, with a sensor which screws into a glow plug hole and 'sees' the light of combustion.

13 Not all diesel engines have ready-made timing marks. If the engine has a TDC sensor, and the timing equipment can read the sensor output, this is not a problem. Some engines have neither timing marks nor TDC sensors; in such cases, there is no choice but to establish TDC accurately, and make suitable marks on the flywheel or crankshaft pulley.

14 For these reasons, dynamic timing methods and the tools required are not described in this book.



4.2 Typical injector tester in use on the bench ...



3.7 DTI and adapter used for timing Lucas/CAV pump

4 Injector testing equipment

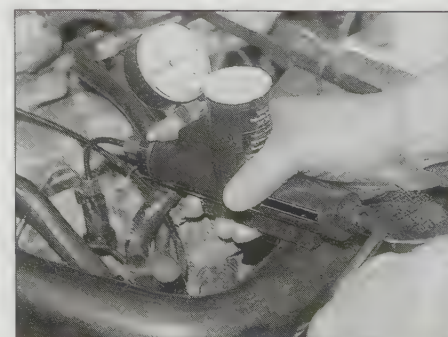


Warning: never expose the hands, face or any other part of the body to injector spray. The high working pressure can penetrate the skin, with potentially fatal results. When possible, use injector test fluid rather than fuel for testing. Take precautions to avoid inhaling the vaporised fuel or injector test fluid. Remember that even diesel fuel is inflammable when vaporised.

1 Some kind of injector tester will be needed if it is wished to identify defective injectors, or to test them after cleaning or prolonged storage. Various makes and models are available, but the essential components of all of them are a high-pressure hand-operated pump and a pressure gauge.

2 For safety reasons, injector test or calibration fluid should be used for bench-testing rather than diesel fuel or paraffin (see illustration). Use the fluid specified by the manufacturer of the test equipment if possible.

3 Some of the simpler testers have the advantage that they can be used to test opening pressure and back-leakage without removing the injectors from the engine (see illustration). A small reservoir may make such



4.3 ... and on the engine

testers of limited use for bench-testing, but good results can be obtained with practice.

4 Another method of testing injectors on the engine is to connect a pressure gauge into the line between the injection pump and the injector. This test can also detect faults caused by the injection pump high-pressure piston or delivery valve.

5 The workshop which tests or calibrates injectors regularly will need a bench-mounted tester. These testers have a lever-operated pump, and a larger fluid reservoir than the hand-held tester. The best models also incorporate a transparent chamber for safe viewing of the injector spray pattern, and perhaps a test fluid recirculation system.

6 Some means of extracting the vapour produced when testing, such as a hood connected to the workshop's fume extraction system, is desirable. Although injector test fluid is relatively non-toxic, its vapour is not particularly pleasant to inhale.

5 Injection pump testing and calibration equipment

The equipment needed for testing and calibration of injection pumps is beyond the scope of this book. Any such work should be entrusted to the pump manufacturer's agent – though the opportunity is taken to say yet again that the injection pump is often blamed for faults, when in fact the trouble lies elsewhere.

6 Smoke testing equipment

In most European countries, smoke emission testing is mandatory for heavy goods vehicles, and for passenger vehicles as part of the annual roadworthiness test.

Smoke testing equipment falls into two categories: indirect and direct reading. With the indirect systems, a sample of exhaust gas is passed over a filter paper, and the change in opacity of the paper is measured using a separate machine. With the direct systems, an

optically-sensitive probe measures the opacity of the exhaust gas, and an immediate read-out is available.

7 Electronic fault code readers

Like their petrol engine counterparts, many of the modern electronic diesel engine control systems have a self-diagnostic function, which continually monitors the operation of the system.

The self-diagnostic system is able to detect system faults such as a faulty sensor or actuator, and can allocate a fault code to identify the source of the problem. The system stores any fault codes in the electronic control unit (ECU) memory, and if a fault is present, a warning light will normally be illuminated on the instrument panel to inform the driver.

Fault codes can be read using a suitable electronic fault code reader. Most vehicle manufacturer's produce their own dedicated diagnostic equipment, but aftermarket fault code readers are also available from various manufacturers.

Notes

Chapter 7

Adjustments and checks

Contents

Introduction	1	Injection timing – checking and adjustment	3
Engine speed adjustments	2	Static timing	
Idle speed		Dynamic timing	
Maximum speed			
Anti-stall (residual capacity)			
Cold-idle mechanisms			

1 Introduction

On most conventional fuel injection pumps (ie, pumps without electronic control), it is normally possible to adjust the following settings:

- a) Idle speed.
- b) Anti-stall controls.
- c) External controls (eg, cold idle mechanisms).
- d) Maximum no-load speed.
- e) Injection timing.

Routine adjustments to injection pumps are normally confined to idle speed, anti-stall and external controls, which may include cold idle mechanisms. Checking injection timing is not as routine an operation as checking the ignition timing on a petrol engine. It is necessary when investigating complaints of poor performance, knock and smoke, and

whenever the pump or its drive has been disturbed. This last case often includes timing belt renewal.

Some manufacturers also specify a routine check of maximum no-load speed. The screw which controls this speed is always tamperproofed in production, using a locking wire and seal, paint or a sealing cap. *Breaking or removing this tamperproof device may invalidate any manufacturer's warranty.*

Other adjustment screws may be externally accessible, either directly, or through access plugs; they control functions such as maximum-fuelling, excess-fuelling and transfer pressure. Often these screws or plugs are also tamperproofed. Do not attempt haphazard adjustment of such screws. Normally a pump test bench is needed to set (or reset) them correctly.

The following Sections give general procedures. Details specific to particular models may vary; consult manufacturer's information or the appropriate Haynes *Service*

and *Repair Manual* for further information. Adjustment specifications can be found in Chapter 10.

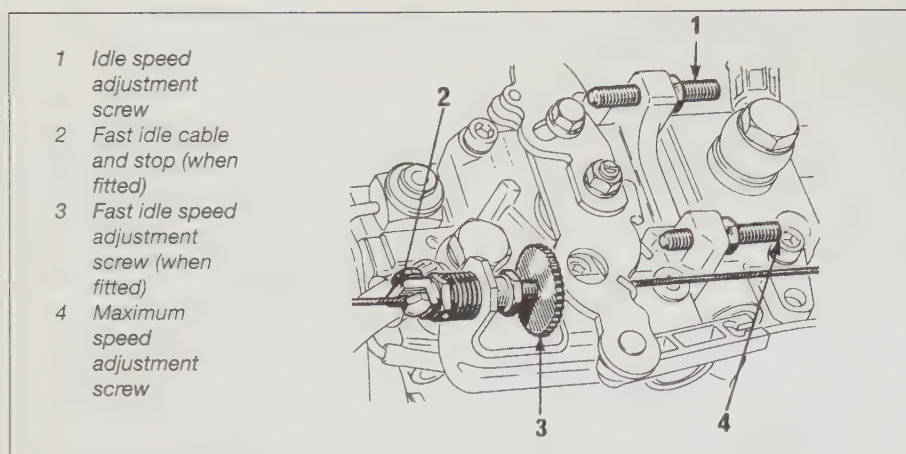
2 Engine speed adjustments

Idle speed

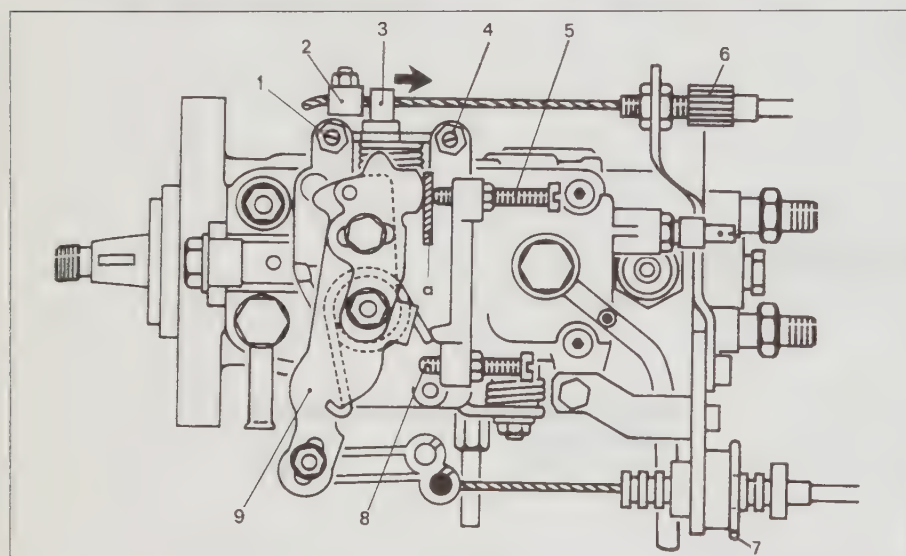
1 Bring the engine to normal operating temperature, and connect a tachometer to it. (For details of tachometers, see Chapter 6.) If a fast idle device is fitted, make sure that it is not holding the pump control lever or idling lever off its stop.

2 Allow the engine to idle, and check the speed against that specified (Chapter 10).

3 If adjustment is necessary, slacken the locknut and turn the idle speed adjusting screw until the speed is correct. If some tolerance is allowed, adjust the speed to the

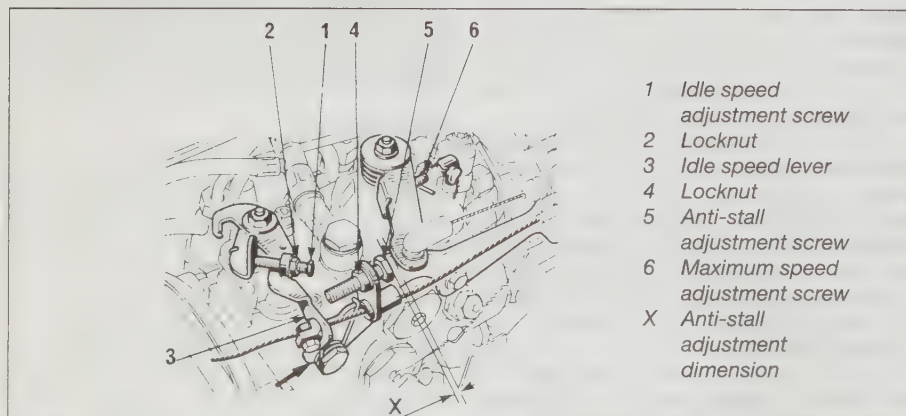


2.3a Typical injection pump adjustment points - Early Bosch VE pump



2.3b Typical injection pump adjustment points - Bosch VE pump with separate idle lever

- | | | |
|------------------------------------|---|----------------------------------|
| 1 Fast idle speed adjustment screw | 5 Anti-stall (residual capacity) adjustment screw | 8 Maximum speed adjustment screw |
| 2 Fast idle cable end stop | 6 Fast idle cable adjuster | 9 Control lever |
| 3 Idle lever | | a Shim for anti-stall adjustment |
| 4 Idle speed adjustment screw | 7 Accelerator cable adjuster | |



2.3c Typical injection pump adjustment points - Lucas/CAV DPC pump

value within the specified range where the engine runs most smoothly. Tighten the locknut when adjustment is correct (see illustrations).

4 On some pumps, it is necessary to check the anti-stall adjustment if the idle speed is altered.

Maximum speed



Warning: Breaking or removing this tamperproof device may invalidate any manufacturer's warranty.

5 With the engine warmed up and a tachometer connected, accelerate the engine to maximum speed for a few seconds. Note the speed reached, and compare it with that specified in Chapter 10. Do not hold maximum speed for any longer than is necessary.

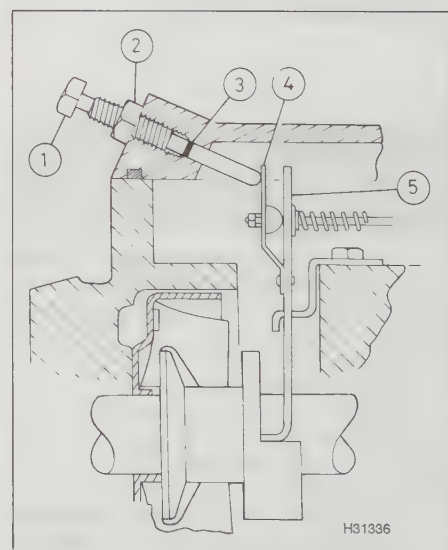
6 If adjustment is necessary, remove the tamperproofing, slacken the locknut, and turn the adjustment screw. Repeat the check; tighten the locknut and fit a new tamperproof device when adjustment is correct.

Anti-stall (residual capacity)

7 Anti-stall or residual capacity adjustment determines how quickly engine speed falls off when the accelerator is suddenly released. If the adjustment is incorrect, the engine will either tend to stall after sudden deceleration, or it will 'hang' (fail to lose its speed quickly enough).

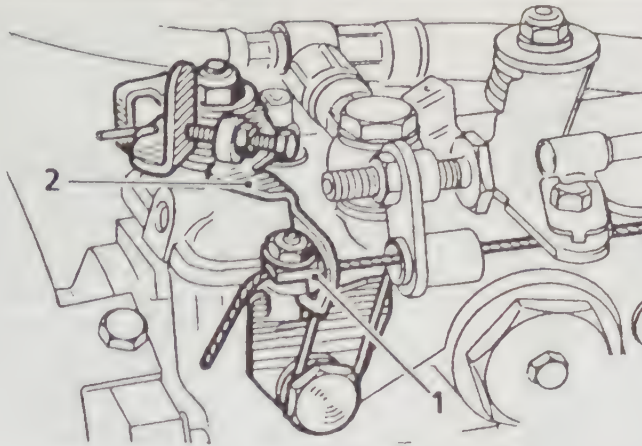
8 All CAV DP series pumps have some kind of external anti-stall adjustment facility, but most Bosch VE pumps do not (see illustration).

9 When the anti-stall adjustment screw determines the resting position of the pump



2.8 Separate anti-stall adjustment screw (1) on Lucas/CAV DPC pump with all-speed mechanical governor

- | | |
|-----------|----------------|
| 2 Locknut | 4 Spring |
| 3 Seal | 5 Governor arm |



2.13a Cold idle adjustment – Lucas/CAV DPC pump with remote thermostatic capsule

When cold, adjust cable clamp (1) to hold idle lever (2) against its stop

control lever, the adjustment procedure usually consists of inserting a specified thickness of shim (or feeler gauge) between the screw and the lever, and noting the effect on idle speed. Idle speed and anti-stall adjustments are connected; if one is adjusted, it will normally be necessary to check the other.

10 When the anti-stall screw is separate, adjustment is normally on a trial-and-error basis, moving the screw by a quarter-of-a-turn at a time. Turning the screw inwards will reduce the tendency to stall; turning it outwards will reduce the tendency to 'hang'.

The effect of a change in adjustment is judged by accelerating the engine to maximum no-load speed, and then releasing the accelerator. The engine must return to idle speed within a specified number of seconds (typically 5 seconds) without stalling.

Cold-idle mechanisms

11 Cold-idle mechanisms may be automatically operated, or they may be operated by the driver using a hand control. When in operation, they may affect injection timing, idle speed or both.

12 Adjustment of the manually-operated mechanism is normally confined to checking that operation of the hand control produces the appropriate movement of the control lever on the pump, and adjusting the cable if necessary.

13 Automatic mechanisms which rely on the movement of a lever by a thermostatic capsule and a cable may also require the cable to be adjusted. If the mechanism alters both timing and idle speed, the relationship between the two functions must also be checked (see illustrations).

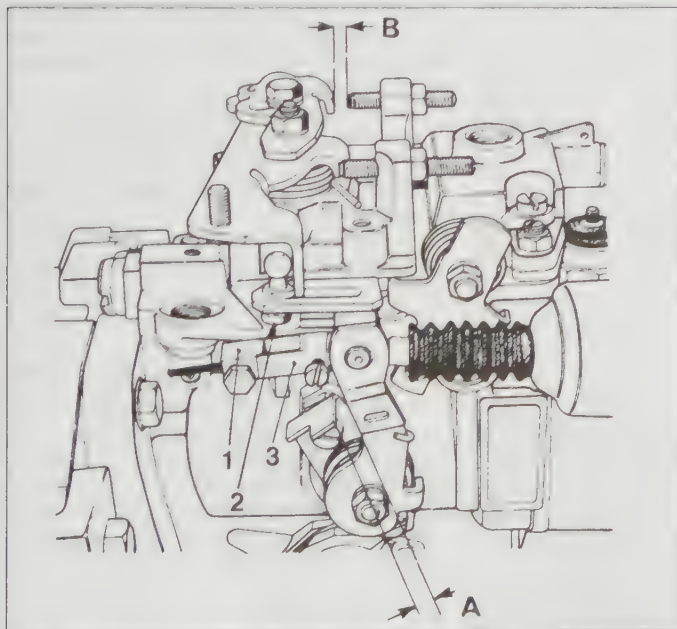
14 Other types of automatic cold-idle mechanism alter the injection pump timing by raising the transfer pressure. Typically, this is done by an electrically-heated thermostatic capsule, which opens a valve as it warms up; no adjustment is possible.

3 Injection timing – checking and adjustment

Static timing

1 Static timing is still the most widely-used method of setting diesel injection pumps. Precision measuring instruments are often needed for dealing with distributor pumps. Good results depend on the skill and patience of the operator.

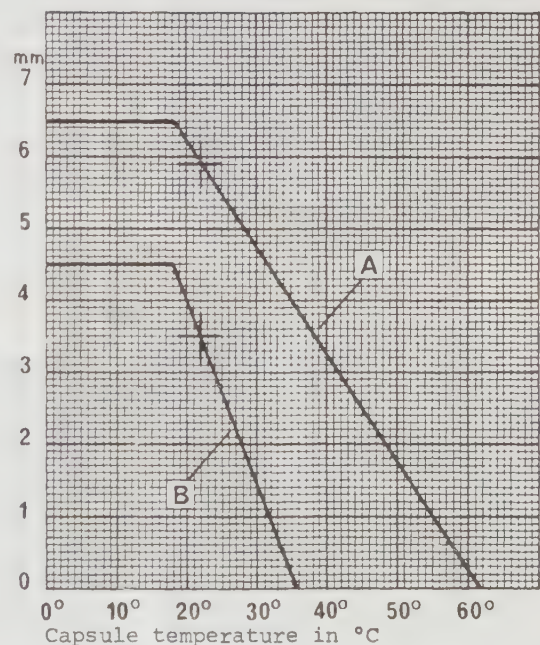
Caution: *Be careful not to introduce dirt into the injection pump during the following procedures.*



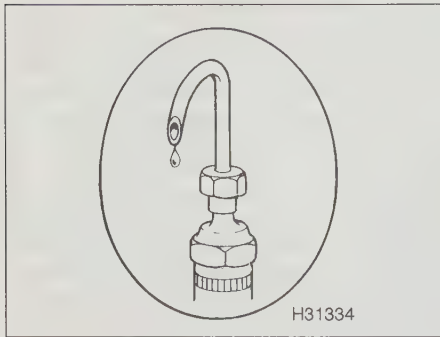
2.13b Cold idle adjustment check points – Bosch VE pump with thermostatic capsule

- 1 Cable end stop
- 2 Ball-pin adjusting nut
- 3 Clevis

- A Advance lever gap
- B Fast idle gap



2.13c Relationship between advance lever gap (A) and fast idle gap (B) varies with temperature – Bosch VE pump with thermostatic capsule



3.2 Typical spill tube

Spill timing (in-line pumps) – low-pressure method

2 This is a simple method of timing, albeit messy. The only special equipment required is a 'spill' or 'swan-neck' tube; this can be made in the workshop using part of an old injector pipe if wished (see illustration).

3 The procedure finds the point in the pump cycle when one plunger covers its inlet port. This corresponds to the beginning of the retraction stroke (Chapter 2, Section 5). It can be accurately related to the engine cycle, but does not necessarily correspond to the actual beginning of injection.

4 Bring the engine to TDC, No 1 piston firing. Clean around the injector pipe unions and the connections on the pump, then remove No 1 cylinder injector pipe.

5 Unscrew No 1 cylinder pipe connection from the pump. Remove the delivery valve plunger and spring, noting which way up the plunger is fitted (see illustration). Do not remove the valve carrier. Refit the connector and sealing washer, and fit the spill tube to the holder.

6 Make sure that the stop control is in the 'run' position. In the case of a vacuum-operated stop control, disconnect the vacuum hose. Fix the pump control lever in the maximum-speed position.

7 The fuel in the pump must now be subject to a small head of fuel pressure. On systems



3.5 Pipe connector and delivery valve components

- 1 Connector
- 2 O-ring
- 3 Spring

- 4 Plunger
- 5 Sealing washer
- 6 Valve carrier

where the fuel filter is higher than the pump, the filter will serve as a header tank. Open the filter bleed screw, and operate the hand-priming pump until fuel emerges.

8 On systems where the fuel filter is lower than the pump, the necessary pressure can be provided by disconnecting the fuel inlet from the pump, and substituting a feed from a small reservoir of clean fuel positioned higher than the pump.

9 Turn the engine approximately a quarter-turn backwards. Fuel will begin to flow from the tube. Slowly, turn the engine forwards

again towards TDC, until the flow of fuel is reduced to one drop per second (or as specified). This is the spill timing point. Note the crankshaft position (degrees BTDC, or alignment of a peg hole), and compare it with that specified.

10 If adjustment is necessary, slacken the remaining injector pipe unions and the pump mountings. Turn the pump as necessary to advance or retard the timing, then tighten the mountings and repeat the check.

11 Disconnect the spill tube. Reassemble the delivery valve, using new sealing washers if necessary, being careful not to introduce dirt into the pump. Refit No 1 cylinder injector pipe, and remake the original fuel supply connections if they were disturbed.

Spill timing (in-line pumps) – high-pressure method

12 If suitable equipment is available, the fuel in the injection pump can be pressurised sufficiently to pass the delivery valve. There is thus no need to dismantle the delivery valve, with a consequent saving in time, although it will be necessary to block off the pump fuel return.

13 Because of the higher pressure involved, fuel flow from the spill tube will be much faster. The spill timing point is typically defined as the point where the jet of fuel from the spill tube turns into a chain of drops.

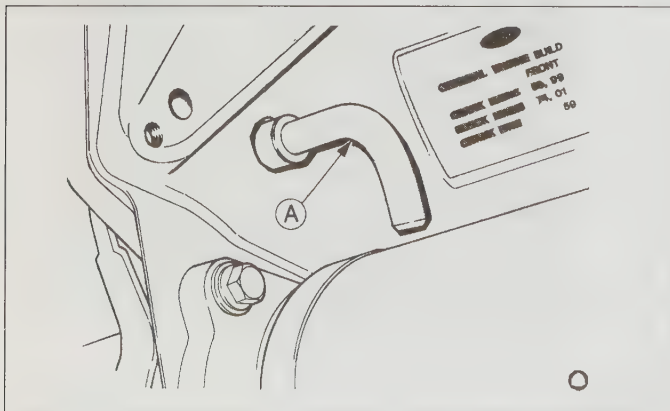
14 Apart from the points just noted, the procedure is the same as for the low-pressure method.

Peg systems (all pump types, when applicable)

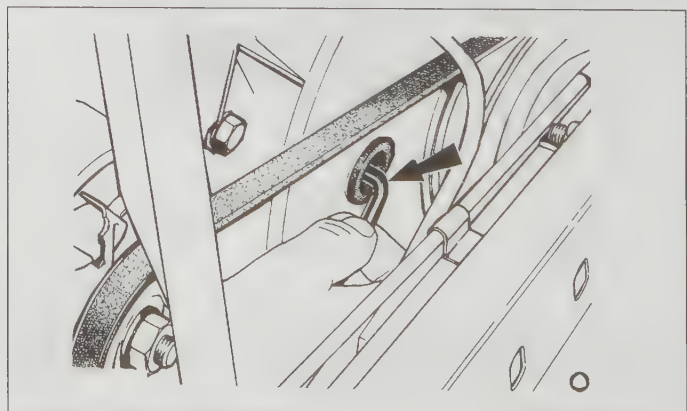
15 Determine the location of the peg holes for the injection pump and the crankshaft or flywheel (as applicable), and the sizes of peg required.

16 Turn the engine until the crankshaft or flywheel timing peg can be inserted cleanly. With this peg in position, it must be possible to insert the injection pump peg (see illustrations).

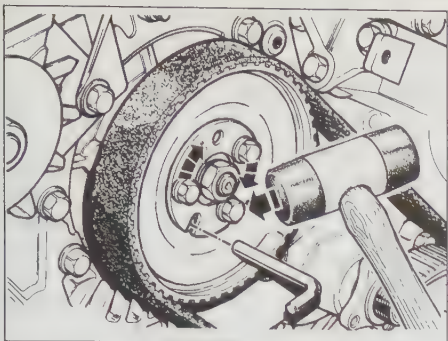
17 If adjustment is necessary, this may either be carried out by slackening the injector pipe



3.16a Flywheel timing peg (A) inserted – Ford 2.5 DI engine

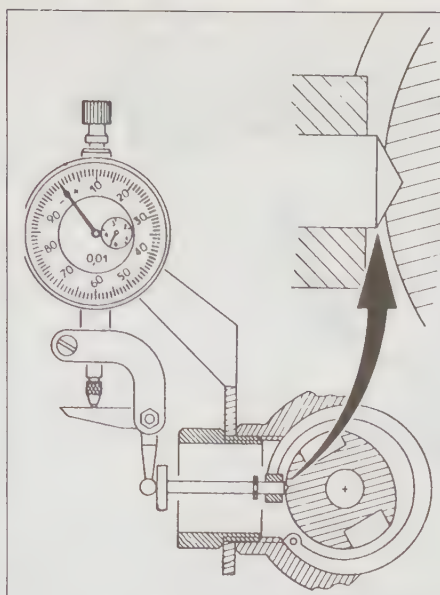


3.16b Inserting the pump timing peg (arrowed) through the timing cover access hole – Ford 2.5 DI engine



3.17 Altering the pump flange-to-sprocket relationship so that the peg can be inserted

Bolts must be slackened first!



3.19 Side-entry timing of Lucas/CAV DP series pump

somewhere on the pump (see illustrations).

26 If adjustment is necessary, refer to paragraph 17.

Bosch VE rear-entry

27 Bring the engine to TDC, No 1 piston firing. Remove the access plug from the rear of the injection pump – be prepared for fuel spillage (see illustration).

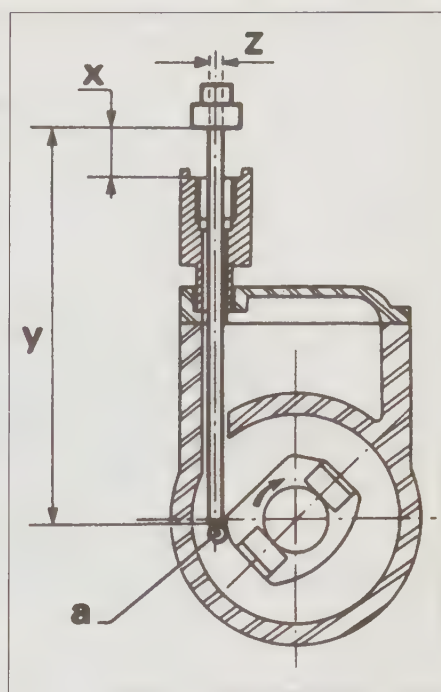
28 Fit a dial test indicator (DTI), adapter and probe, so that the probe enters the access hole and the DTI displays movement of the pump plunger. Removing the injector pipes will improve access. On some pumps it may be necessary to use a right-angle adapter to allow the DTI to fit in the available space at the rear of the pump (see illustrations).

29 Slowly turn the crankshaft anti-clockwise until the DTI reading reaches a minimum (pump plunger BDC), and zero the DTI at this point.

30 Turn the crankshaft clockwise to bring the engine to the specified timing point (see paragraph 20). Read the plunger movement displayed on the DTI, and compare it with the value given in Chapter 10.

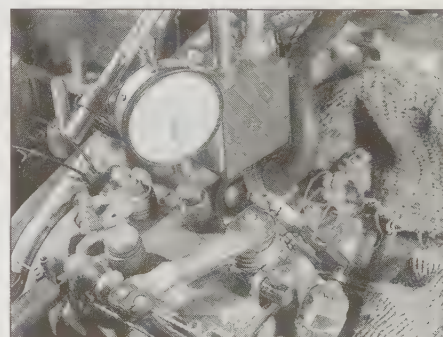


3.27 Removing the access plug from the rear of a Bosch VE pump

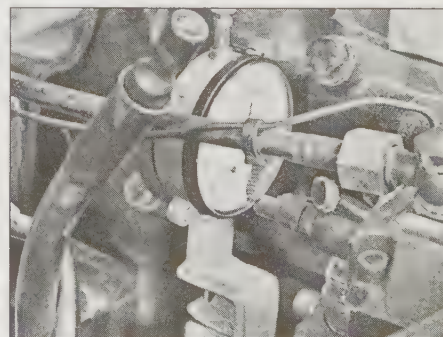


3.25a Sectional view of probe and pump – Lucas/CAV top-entry timing

a	Timing piece	y	95.5 ± 0.01 mm
x	Specified timing value	length	
		z	7 mm diameter



3.25b Reading probe movement – Lucas/CAV top-entry timing



3.28a Dial test indicator and adapter positioned with probe reading plunger movement – Bosch VE pump rear-entry timing

unions and the pump mountings, and turning the pump, or by altering the relationship of the pump drive flange to its gear or sprocket (see illustration). Refer to the manufacturer's information or to the relevant Haynes Service and Repair Manual for the appropriate method. Repeat the timing check from the beginning after adjustment.

CAV DP side-entry

18 Bring the engine to TDC, No 1 piston firing. Remove the access plug from the side of the injection pump – be prepared for fuel spillage.

19 Fit a dial test indicator (DTI) and probe so that the probe enters the access hole, passes through the hole in the circlip, and rests on the pump rotor. Slowly turn the crankshaft anti-clockwise to find the DTI minimum reading. In this position, the probe is resting in the bottom of the timing groove in the rotor (see illustration).

20 Turn the crankshaft clockwise to bring the engine to the specified timing point. This may be TDC, or it may be a specified point before or after TDC – see Chapter 10. (If the timing point is overshoot, return to the zero position established in the previous paragraph, and start again.)

21 Read the probe movement displayed on the DTI, and compare it with the value given in Chapter 10. If adjustment is necessary, refer to paragraph 17.

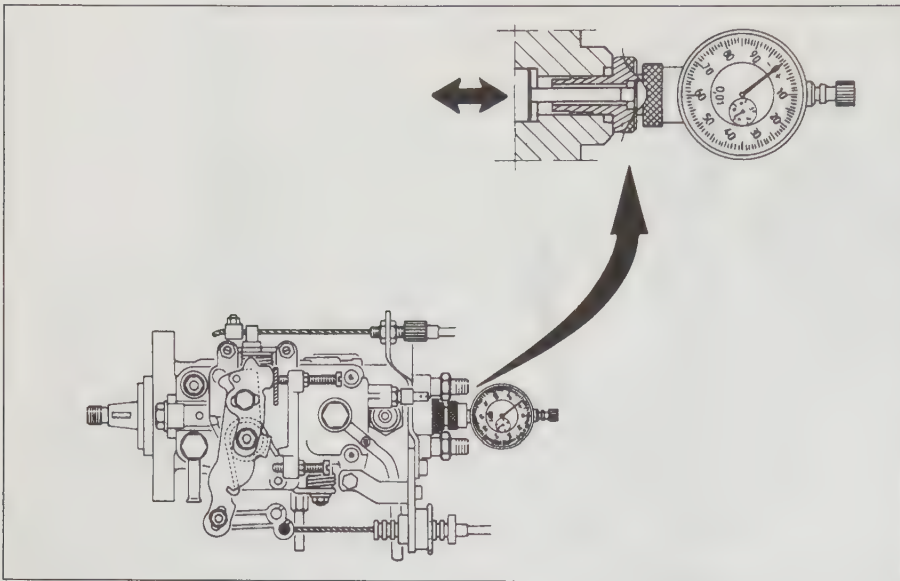
CAV DP top-entry

22 Bring the engine to TDC, No 1 piston firing. Remove the access plug from the top of the injection pump.

23 Insert a probe of the specified length into the access plug hole, so that the tip of the probe rests on the rotor timing piece. Position a dial test indicator to read the movement of the probe.

24 Turn the crankshaft approximately a quarter-turn backwards, and zero the DTI.

25 Turn the crankshaft clockwise to bring the engine to the specified timing point (see paragraph 20). Read the probe movement displayed on the DTI, and compare it with the value engraved on the plastic disc or tag



3.28b Rear-entry timing of Bosch VE pump

31 If adjustment is necessary, see paragraph 17.

Dynamic timing

32 As the name implies, dynamic timing is carried out with the engine running. Special equipment is required to carry out dynamic timing accurately, and this is unlikely to be available to the home mechanic. The equipment works by converting pressure pulses in an injector pipe into electrical signals. If such equipment is available, use it in accordance with its manufacturer's instructions.

33 Although the pump timing is checked with the engine running, any adjustment is usually carried out with the engine stopped.

34 An additional problem is that few manufacturers specify figures for dynamic timing.

35 For these reasons, static timing is generally an easier method of timing than dynamic timing, and we have chosen not to include specific details of dynamic timing in this book.

Chapter 8

Maintenance and repair operations

Contents

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Maintenance procedures	2	Fuel injection pump removal and refitting	
Engine oil and filter renewal		Injector testing, inspection and adjustment procedures	4
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Fuel filter renewal		Testing on the vehicle	
Fuel system bleeding		Removal and refitting	
Auxiliary drivebelt checks		Cleaning and inspection	
Fuel injection pump checks and adjustments		Bench-testing	
Fuel injector checks		Interpretation of results	
Exhaust emissions check		Adjustment of opening (or 'breaking' pressure (calibration)	
Timing belt renewal		Glow plugs - removal, inspection and refitting	5
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1 Introduction

Maintenance procedures

Due to the high working pressures, loads and temperatures found in a diesel engine, the recommended service intervals (especially oil change intervals) are generally more frequent than those for a comparable petrol engine. Frequent oil changes are particularly important for a diesel engine, as dirt or soot builds up in the oil during normal operation, leading to the deterioration of the oil's lubricating qualities.

The vehicle manufacturer's service schedule should always be followed, and it is important to use good quality lubricants and filters, which meet the manufacturer's recommendations.

This Chapter does not provide specific procedures for maintenance operations, its purpose is to provide a general guide to

operations which are particularly important, or unique to diesel engines. Examples of such operations are:

- Engine oil and filter renewal.
- Draining water from the fuel filter/water separator.
- Fuel filter renewal.
- Fuel system bleeding.
- Auxiliary drivebelt checks.
- Fuel injection pump checks and adjustments.
- Fuel injector checks.
- Exhaust emissions check.
- Timing belt renewal.
- Turbocharger boost pressure check.

Repair procedures

When overhauling a diesel engine, there may be various unique features which need to be taken into account.

Always consult with the manufacturer's engine overhaul information, especially when carrying out work on the cylinder head; for example when renewing the cylinder head

gasket, it may be necessary to measure the distance by which the pistons protrude from the cylinder block, in order to determine the correct thickness of cylinder head gasket.

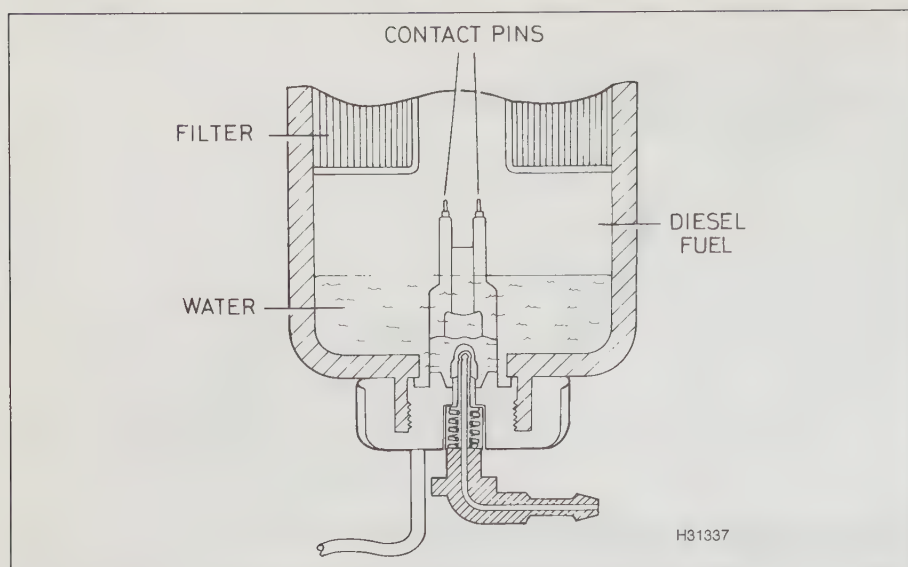
Typical examples of such features are given in the following Sections.

2 Maintenance procedures

Note: This Section does not provide an exhaustive list of diesel engine maintenance procedures, it gives basic information and advice on tasks which are especially important or unique to diesel engines. Always refer to the manufacturer's information for a detailed description of maintenance operations.

Engine oil and filter renewal

1 Generally, the recommended engine oil and filter change intervals will be more frequent than those for petrol engines.



2.3 Sectional view of fuel filter with water sensor

2 It is important to use a good quality oil which is recommended for use in diesel engines.

Draining water from the fuel filter/water trap

3 If a glass bowl water trap is fitted, it is easy to see when water is accumulating in the bottom of it. When the water trap is incorporated into the filter base, the water cannot be seen. Sometimes a sensor is fitted, which illuminates a warning light to alert the driver to the presence of water (see illustration).

4 Manufacturer's recommendations for the intervals at which the water trap should be drained vary widely. Obviously, operating conditions and fuel quality will determine the rate at which water accumulates, but it is better to err on the side of safety and drain the trap frequently. If water gets to through to the pump and injectors, it can cause serious damage.

5 When draining the water trap, place a small container under it to catch the fuel. It is important that fuel is not allowed to spill onto the coolant hoses, alternator, starter motor or engine mountings. Protect them with plastic sheet if necessary. On some models, the trap or filter is awkwardly placed; in such cases, it may be easier to fit a length of hose to the trap outlet.

6 On certain popular models, the filter is notoriously difficult to drain, because the brake servo or some other component effectively blocks access to the base of the filter. In these cases, it is necessary to unbolt the filter head from the bulkhead, or to make up a tool to slacken the drain screw *in situ*.

7 When the drain screw is opened, it may be found that no fuel emerges because the system is under negative pressure. Slacken the bleed screw or the inlet union on the filter

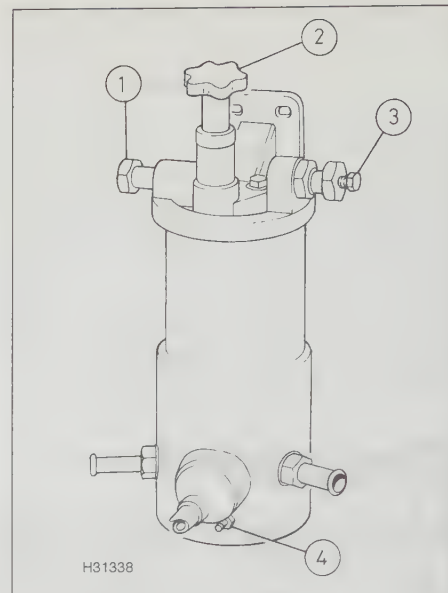
head, or operate the hand-priming pump, until fuel flows (see illustration).

8 When clean fuel, free of water droplets, flows out, tighten the drain screw and the bleed screw.

9 Dispose of the drained fuel and water safely, in the same way as used engine oil.

Fuel filter renewal

10 The main filter element must be renewed at the intervals specified by the manufacturer, or more often if experience of particular

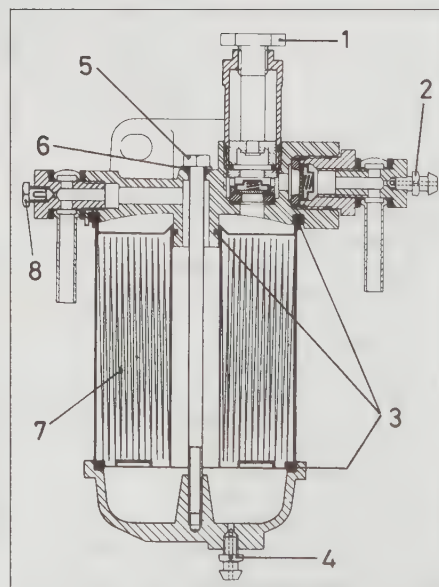


2.7 Fuel filter drain screw (4) - Lucas/CAV filter with coolant-heater base

- | | |
|---------------------|---------------------|
| 1 Inlet union | 3 Fuel bleed screw |
| 2 Hand-priming pump | 4 Water drain screw |

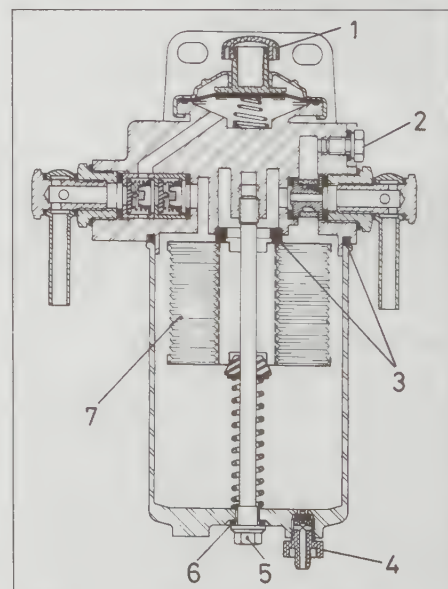
problems show it to be necessary. Some manufacturers specify renewal at the beginning of every winter, even if little mileage has been covered, to reduce the risk of waxing problems.

11 Filters are basically of two types: cartridge and canister (see illustrations). Cartridge



2.11a Sectional view of cartridge fuel filter with separate bowl

- | | |
|---------------------|---------------------|
| 1 Hand-priming pump | 4 Water drain screw |
| 2 Fuel bleed screw | 5 Through-bolt |
| 3 Seals | 6 Through-bolt seal |
| | 7 Filter element |
| | 8 Air bleed screw |



2.11b Sectional view of canister fuel filter

- | | |
|---------------------|---------------------|
| 1 Hand-priming pump | 4 Water drain screw |
| 2 Fuel bleed screw | 5 Through-bolt |
| 3 Seals | 6 Through-bolt seal |
| | 7 Filter element |

filters can be subdivided into 'spin-on' type, similar to a modern engine oil filter, 'clamp' type retained by a clamping strap or band, and 'through-bolt' type, retained by a bolt running from the filter head to a separate bowl. Canister filters are totally enclosed in the filter bowl.

12 It is best to drain the filter before removal if possible. The filter is then unscrewed with a strap or chain wrench ('spin-on' type), or the through-bolt or clamp bolt removed, according to type. Make sure that the old seals are recovered: some filter heads have a seal in a groove which is easy to overlook. The through-bolt, where fitted, may have an O-ring seal under its head. Any imperfect seals can allow air to be drawn into the system if there is no lift pump, or fuel to be forced out if there is.

13 Wipe out the filter bowl or canister, if applicable, finishing off with a **clean** non-fluffy cloth, or (if available) compressed air.

Caution: It is important that **no dirt is introduced into the system.**

14 Smear the new seals with a little clean fuel. If a central seal retainer is fitted, make sure it is secure; in the case of the canister filter, make sure the seal is snugly in its groove.

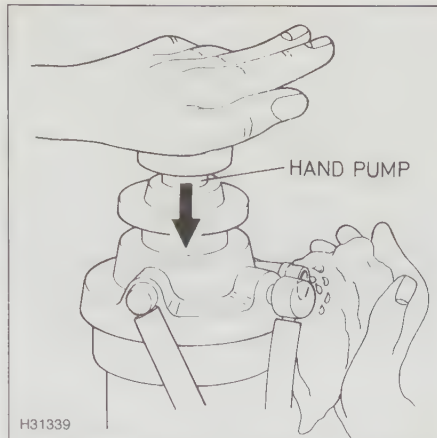
15 Fit and secure the new filter or element, then bleed the fuel system if necessary.

16 If a separate water trap or pre-filter is fitted, this may incorporate a gauze screen, which should be removed for cleaning at the specified intervals.

Fuel system bleeding

17 Bleeding of the fuel system is necessary after operations in which air has been allowed to enter fuel lines, and after running out of fuel. General procedures are given here: refer to manufacturers information or to the relevant *Haynes Service and Repair Manual* for specific details.

18 Modern fuel systems are of the self-bleeding type. If no hand-priming pump is fitted, the normal way of bleeding such a system is by cranking the engine on the starter motor in 10-second bursts. If a hand-operated vacuum pump is available, this can be connected to the injection pump fuel return



2.19 Bleeding the fuel system at the filter head

connection and used to suck fuel through the supply lines and filter; this will obviously save the battery a good deal of work.

19 When a hand-priming pump is fitted, this is operated first, with the bleed screw on the filter head open. When fuel free from air bubbles emerges, tighten the bleed screw (**see illustration**). Carry on pumping until increased resistance is felt. Alternatively, use a vacuum pump as just described; this avoids any risk of splitting the diaphragm on the hand-priming pump, an occurrence which is not unknown on older vehicles.

20 If air has reached the injection pump, this may be bled out at a specific bleed screw if fitted, or (more usually) at the fuel return union (**see illustration**).

21 On engines fitted with an in-line or distributor injection pump, if air has entered the injector pipes, slacken the injector unions, and crank the engine on the starter motor. When fuel emerges, tighten the unions and mop up spilt fuel.

22 When a separate fuel lift pump is fitted, this usually has a hand-priming lever for use when bleeding (**see illustration**). If the engine has stopped with the lift pump operating arm

on top of its cam, it will be necessary to turn the engine before the hand-priming lever can be used.

Auxiliary drivebelt checks

23 On some diesel engines, besides the usual auxiliary drivebelt(s) used to drive ancillary units such as the alternator, power steering pump, etc., an additional drivebelt may be used to drive the brake vacuum pump, and in some cases the injection pump (most conventional injection pumps are driven by the engine timing belt).

24 Where applicable, checking of the vacuum pump and/or injection pump drivebelts should not be overlooked when carrying out routine maintenance. Always renew a drivebelt if there is any doubt about its condition.

Fuel injection pump checks and adjustments

25 On all models, the idle and maximum speeds should be checked at the manufacturer's specified intervals – see Chapter 7, Section 2 for general procedures.

26 Depending on the type of injection pump and the control systems fitted to it, there may also be a need to check the operation of the anti-stall and cold start devices. Again, general procedures are described in Chapter 7.

27 Inspect the injection pump control linkages at every service interval. Lubricate them if necessary, and renew any frayed or sticking cables. Check that fully depressing the accelerator pedal produces full movement of the pump control lever.

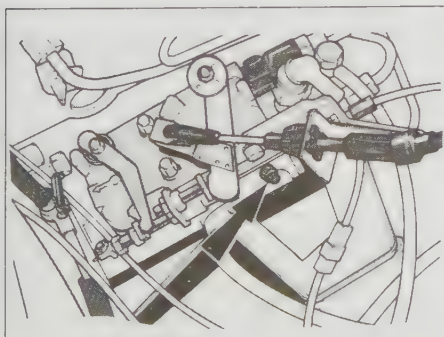
28 At the same intervals, inspect the fuel injector high-pressure pipes and their securing clips for security and condition. Also inspect the fuel return pipes or hoses, and (when applicable) the turbo boost pressure hose which connects the inlet manifold to the injection pump. Renew any leaking or damaged components.

Fuel injector checks

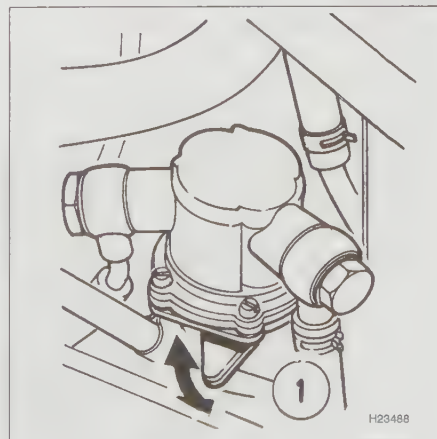
29 Some manufacturers specify that the injectors should be removed and inspected periodically, but generally they are ignored unless particular problems (excessive smoke, knocking or power loss) suggest that they may be giving trouble.

30 If suitable equipment is available for on-vehicle testing (see Chapter 6), it is worth checking the injector opening pressures after the first 48 000 miles (77 000 km), and then every 24 000 miles (39 000 km) or so. Testing, cleaning and calibration procedures are given Section 4.

31 Fuel injector cleaners are available in the form of fuel additives. If used as directed they are unlikely to be harmful, and may indeed do some good; note however that some vehicle manufacturers specifically forbid their use.



2.20 Injection pump bleed screw (arrowed) – pre-1985 Ford 2.1 litre engine



2.22 Hand-priming lever (1) on separate fuel lift pump

Exhaust emissions check

32 The only emission test applicable to diesel engines is the measuring of exhaust smoke density. The test involves the use of special test equipment (see Chapter 6), and forms part of the MoT test for vehicles in the UK.

33 The test involves accelerating the engine several times to its maximum unloaded speed, and so it is vital to ensure that the engine timing belt is in good condition before the test is carried out. Refer to Chapter 9 for details of possible causes of excessive smoke.

Timing belt renewal

34 As with petrol engines, if a timing belt is fitted, it is vital to ensure that it is in good condition. On many diesel engines, the timing belt drives the injection pump as well as the camshaft.

35 The timing belt must be renewed at the manufacturer's specified intervals, or more frequently if the vehicle is used in particularly arduous conditions (eg, frequent stop-start driving or taxi work).

36 It is strongly recommended that consideration is given to renewing the timing belt every 36 000 miles (58 000 km), regardless of the manufacturer's recommended renewal intervals.

Turbocharger boost pressure check

37 Some manufacturers recommend that a turbocharger boost pressure check is carried out as part of the routine maintenance schedule. Details of this check are given in Chapter 4, Section 3.

3 Engine repair and overhaul procedures

General

1 Always refer to the manufacturer's recommended procedures and specifications when carrying out any engine repair or overhaul work.

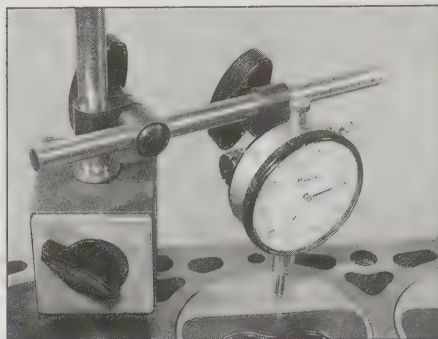
2 Although diesel engine components are generally similar to their petrol counterparts, there may be detailed differences. For instance, piston cooling oil spray jets may be fitted in the crankcase, and the brake vacuum pump may be driven by an auxiliary shaft.

3 It is always advisable to follow the manufacturer's repair instructions in case there are any special procedures which need to be followed, or any particular specifications which must be checked before rebuilding the engine.

Cylinder head removal and refitting

Cylinder head gasket selection

4 On many diesel engines, when carrying out work which involves removal and refitting of



3.6 Measuring piston protrusion

the cylinder head, it is necessary to carry out a measurement of the protrusion of the pistons from the top surface of the cylinder block, to determine the thickness of cylinder head gasket to use on refitting.

5 The following procedure is a typical procedure for a Peugeot/Citroën XUD type engine. Refer to the manufacturer's information or the relevant Haynes Service and Repair Manual for specific details.

6 With the cylinder head removed, turn the crankshaft until pistons 1 and 4 are at TDC. Position a dial test indicator (DTI) on the cylinder block, and zero it on the block face. Transfer the probe to the centre of the flat section of No 1 piston crown (clear of the combustion chamber, where applicable), then slowly turn the crankshaft back-and-forth past TDC, noting the highest reading obtained on the DTI (see illustration). Record this reading.

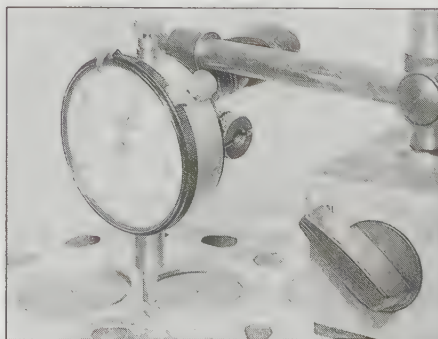
7 Repeat this measurement on No 4 piston, then turn the crankshaft half a turn (180°) and repeat the procedure on Nos 2 and 3 pistons.

8 Ascertain the greatest piston protrusion measurement, and use this to determine the correct cylinder head gasket from the manufacturer's information. E.g:

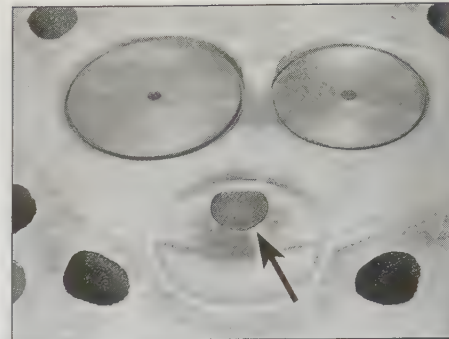
Piston protrusion	Gasket identification
0.54 to 0.65 mm	1 notch
0.65 to 0.77 mm	2 notches
0.77 to 0.82 mm	3 notches

Swirl chamber condition and protrusion/recess checking

9 On direct injection engines, it is advisable to check the condition of the swirl chambers



3.11a Zero the dial test indicator on the cylinder head face ...



3.9 This swirl chamber shows the initial stages of cracking and burning (arrowed)

whenever the cylinder head is removed. Inspect the swirl chambers for burning or cracks (see illustration). The swirl chambers can be renewed, but the work should be entrusted to a specialist.

10 On some engines it is necessary to check the protrusion or recess (as applicable) of the swirl chambers whenever the cylinder head is removed.

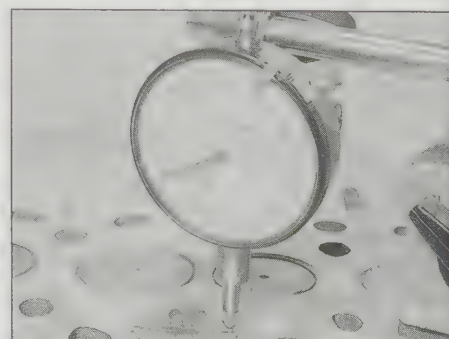
11 This can be done using a DTI in a similar manner to that described for the measurement of piston protrusion. Zero the DTI on the cylinder head face, then transfer the probe to the swirl chamber and measure the protrusion or recess (see illustrations).

12 On some engines, the swirl chambers can be adjusted using shims; on others, the relevant swirl chamber(s) will have to be renewed if the protrusion/recess does not meet the manufacturer's specifications.

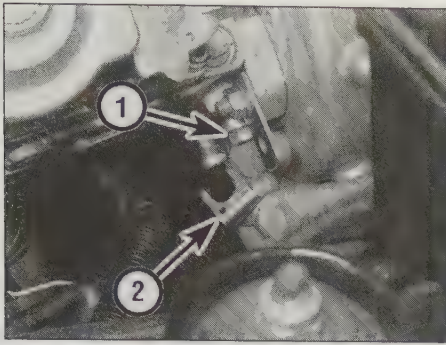
Fuel injection pump removal and refitting

13 Always ensure that the engine timing marks are in alignment when removing or refitting an injection pump. Timing marks are usually provided on the crankshaft, camshaft and injection pump sprockets. Where applicable, ensure that the timing pegs are in position in the injection pump and flywheel or crankshaft, as applicable (see Chapter 7, Section 3).

14 When removing certain types of fuel injection pump (such as those used on some Land Rover engines), the manufacturers may recommend that the pump rotor is locked in



3.11b ... then check the swirl chamber protrusion



3.14 Injection pump rotor keeper plate screw (1) and keeper plate (2) – Land Rover 300 TDi engine

position before removal, by removing a keeper plate. The pump is then locked by refitting the keeper plate screw (see illustration). This effectively locks the pump rotor in position, retaining the pump timing.

4 Injector testing, inspection and adjustment procedures

Note: The information given in this Section refers to conventional diesel fuel injectors. For details of the injectors used in common rail and 'pump injector' systems, refer to Chapter 2, Sections 9 and 10 respectively.

General

1 Refer to Chapter 2, Section 7 for a description of how typical fuel injectors function.

Testing on the vehicle



Warning: Never expose the hands, face, or any other part of the body to injector spray; the high working pressure can

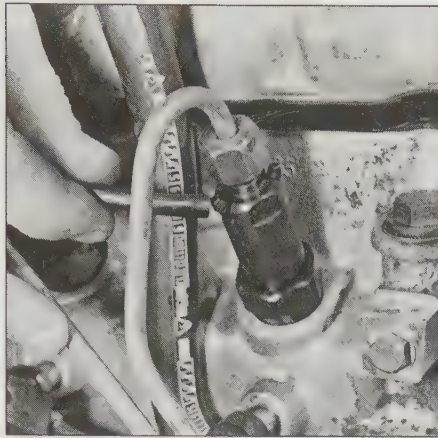
penetrate the skin, with potentially fatal results.

2 A faulty injector which is causing knocking noises can be identified as follows.

3 Clean around the injector fuel pipe unions. Run the engine at a fast idle so that the knock can be heard. Using a suitable split ring spanner, slacken and retighten each injector union in turn. (Cover the union with a piece of rag to absorb the fuel which will be spilt.)

4 When the union supplying the defective injector is slackened, the knock will disappear. Stop the engine, and remove the injector for inspection. Before condemning the injector, make sure that the problem is not caused by a missing, damaged or incorrectly fitted heat shield.

5 The balance between injectors can be checked in a similar way, provided an accurate tachometer is available. With the engine idling, each union is slackened in turn, and the drop in engine rpm noted. Any injector which produces a much larger or smaller drop in rpm when its union is slackened should be viewed with suspicion.



4.9 Disconnecting an injector leak-off pipe

6 With suitable equipment, it is possible to check injector opening (or 'breaking') pressures and leakage without removing the injectors from the engine. This is obviously a time-saving measure if it is simply wished to verify that the pressures are correct, or to locate a defective injector.

7 Testing spray pattern by cranking or running the engine with an injector out of its hole and connected to its fuel pipe should not be attempted. It is tempting to use this method because it is quick and requires no special equipment, but the risk of fire and blood poisoning from the injector spray mean that it cannot be recommended.

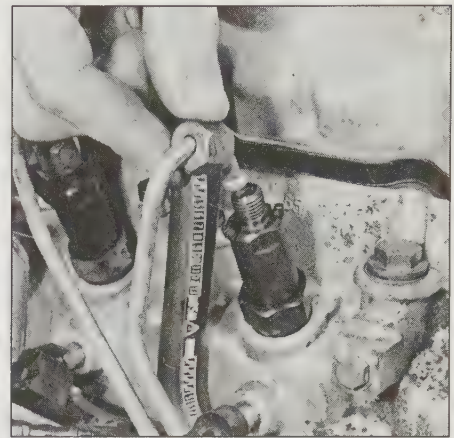
Removal and refitting

Note: This is a general procedure. Refer to the manufacturer's information or to the relevant Haynes Service and Repair Manual for specific details.

Screw-in type

8 Clean around the injector pipe unions, and around the injectors where they meet the cylinder head.

9 Disconnect the leak-off pipes from the



4.10 Disconnecting an injector pipe

injectors, and plug or cap the open pipes (see illustration).

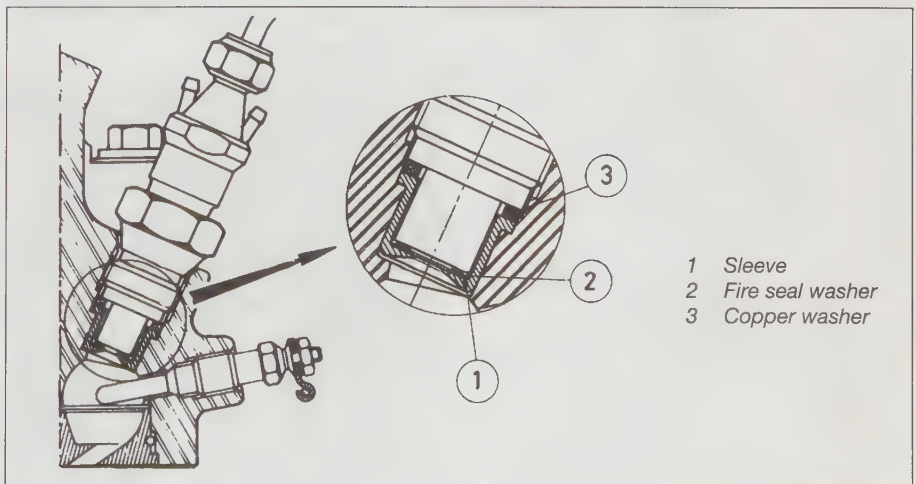
10 Using a split ring spanner, disconnect the unions from the injectors. Move the pipes clear of the injectors. To do this, it is best to slacken the pipe unions at the pump as well, and to release pipe clamps or clips. Alternatively, remove the pipes completely (see illustration).

Caution: Counterhold the delivery valves on the pump when slackening the unions.

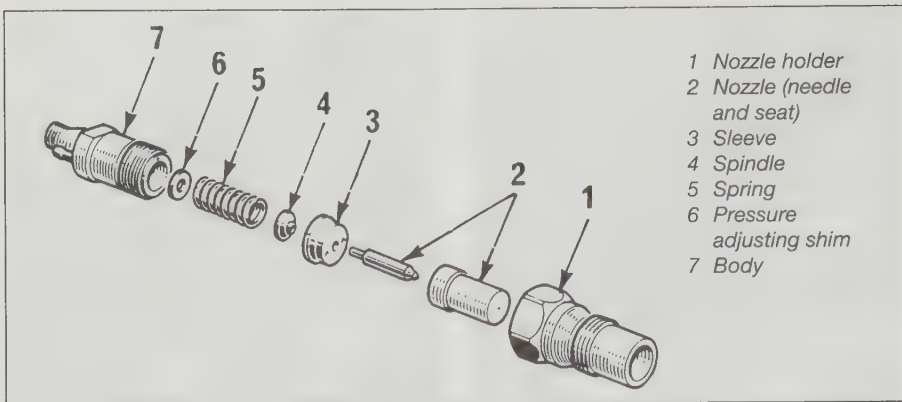
11 Unscrew the injectors using a suitable deep socket, and remove them. Recover any sealing washers, heat shields, etc, and obtain new ones for reassembly. Note which way up each item is fitted (see illustration).

12 Commence refitting by making sure that the injector recesses and sealing surfaces in the cylinder head are clean. Also clean the injectors themselves. On pintle type injectors, be careful not to damage the protruding needle tip.

13 Fit new heat shields, sealing washers, etc, making sure they are the right way up. Fit the injectors and tighten them to the specified torque. Be careful not to cross-thread or overtighten the injectors in an aluminium alloy cylinder head.



4.11 Sectional view of cylinder head, showing injector sealing washer detail



4.19a Exploded view of a Bosch screw-in pintle injector

14 Reconnect the leak-off pipes and the injector pipes. Make sure that the pipe clamps or clips are refitted to their original positions. Before tightening the unions on the injectors, bleed air from the pipes by cranking the engine until fuel emerges.

Clamp or flange type

15 The procedures are similar to the screw-in type described previously, but the injector fixing clamp nuts or bolts must be removed before the injector can be withdrawn. Carbon deposits can cause the injector to stick in its recess; in this case, an injector puller or a

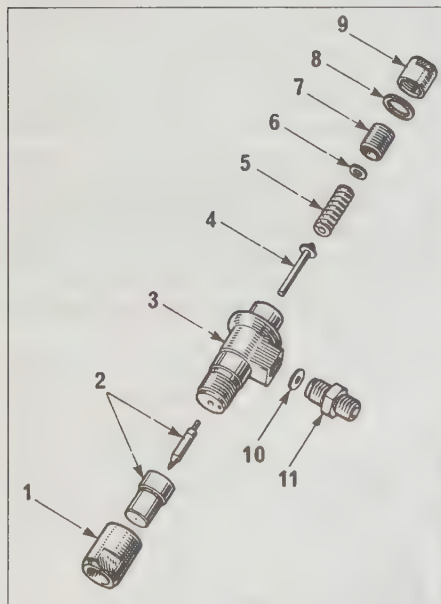
small slide hammer can be used, or it may be possible to free the injector by careful levering. Do not attempt to free a sticking injector by cranking the engine: it could be ejected with enough force to cause damage or serious injury.

Cleaning and inspection

Caution: Diesel fuel is irritating to the skin and eyes. If possible use injector test fluid (which is less toxic) for cleaning and testing. Use barrier cream, and where necessary, goggles and disposable gloves, for protection. Change out of fuel-soaked clothing as soon as possible.

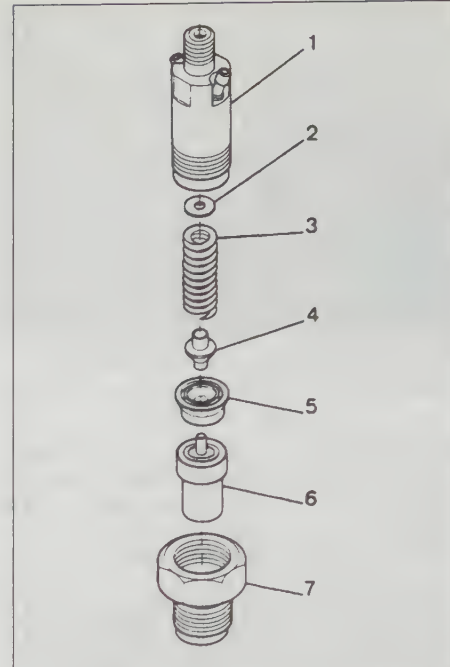
16 Dismantling, cleaning and calibration of injectors may not be an attractive proposition for the small garage or tune-up specialist, who will normally prefer to obtain new or reconditioned injectors on an exchange basis. The procedures are given here for the benefit of the owner-mechanic whose time is not costed at commercial rates, or for situations where replacement injectors are not available. An injector tester will be needed after reassembly, in order to check the injector opening pressure, spray pattern and leakage characteristics.

17 Injectors must only be dismantled and reassembled under conditions of near-surgical cleanliness.



4.19c Exploded view of a RotoDiesel clamp fitting pintle injector

- | | |
|----------------------------|---------------------------------|
| 1 Nozzle holder | 7 Pressure-adjusting screw |
| 2 Nozzle (needle and seat) | 8 Washer |
| 3 Body | 9 Cap nut |
| 4 Spindle | 10 Washer |
| 5 Spring | 11 Injection pipe union adapter |
| 6 Shim (not always fitted) | |



4.19b Exploded view of a RotoDiesel screw-in pintle injector

- | | |
|---------------------------|----------------------------|
| 1 Body | 5 Sleeve |
| 2 Pressure adjusting shim | 6 Nozzle (needle and seat) |
| 3 Spring | 7 Nozzle holder |
| 4 Spindle | |

18 Clean the injector externally, using paraffin or a suitable solvent and a nylon or brass wire brush.

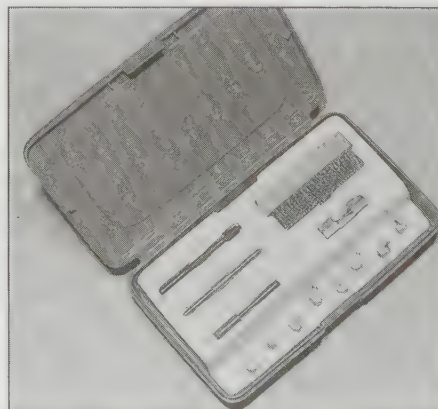
19 Separate the two halves of the injector body by unscrewing them. Ideally a dismantling jig should be used. If a jig is not available, **carefully** clamp the upper or central part of the injector body in a soft-jawed vice. Slacken the other part(s) using a spanner, and separate the injector body components (see illustrations).

20 Remove the internal components from the injector, noting the order in which they are fitted. Do not drop the nozzle. Any copper washers or other seals must be renewed. If dismantling more than one injector, take care not to get the parts mixed up.

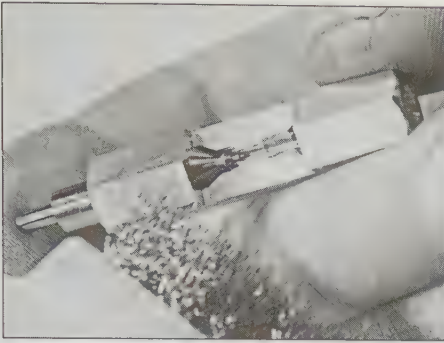
21 Immerse the injector components in clean diesel fuel or injector test fluid as they are removed. Clean them using a solvent such as carburettor cleaner and a wooden or plastic scraper. A nylon or brass-bristled brush, and brass wire can also be used – these are normally supplied as part of an injector cleaning kit (see illustration).

22 The cleaning kit should also include brass probes or scrapers for cleaning carbon from the needle seat. When using these, work from the inside of the seat towards the outside. If a probe is inserted from the outside, there is more likelihood of damage.

23 Pay particular attention to cleaning deposits from the needle tip and seat, using a



4.21 Typical injector cleaning kit



4.23 Cleaning an injector needle in a cleaning jig

cleaning jig to support the needle (**see illustration**). Carbon build-up here can cause 'hosing' or a refusal to 'break' cleanly under test. In the case of 'perforated pintle' type

needles, clean out the drillings with the appropriate diameter brass wire.

24 When using brass wire to clean holes, be careful that it does not snap off in the hole. If this happens, its may be impossible to retrieve it.

25 Inspect all parts for obvious signs of wear or damage. Inspect the needle and its seat closely for ovality, ridging, pitting or other damage to their mating areas. The needle and seat must always be renewed as a matched set. **Do not** attempt to lap them together using grinding paste; this would damage them severely.

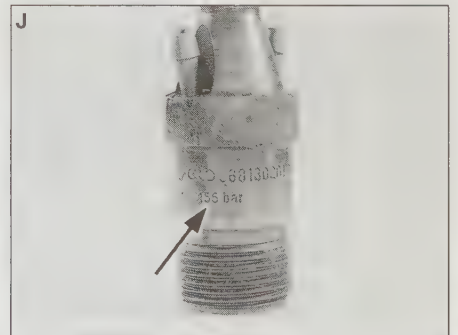
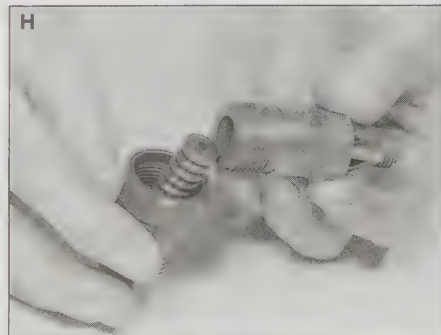
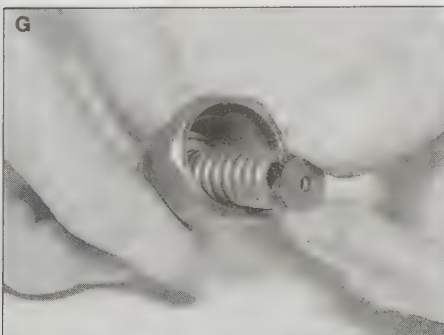
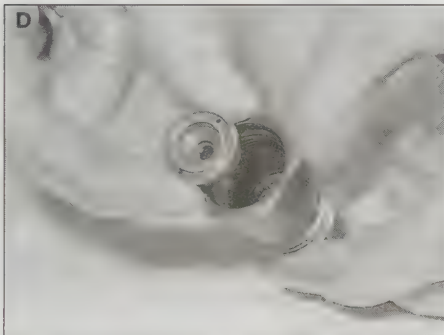
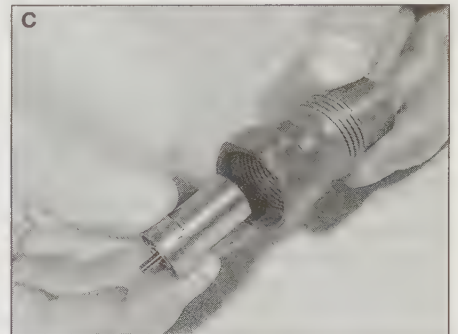
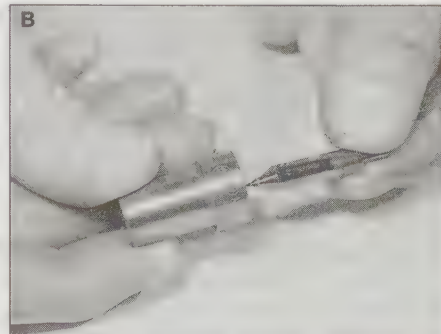
26 Inspect the injector body and base for corrosion and heat discoloration ('blueing'). If serious overheating has occurred, the complete injector must be renewed.

27 If the nozzle appears satisfactory after cleaning, perform a sliding test as follows. Dip

the injector needle in clean test fluid or fuel, and insert it fully into the seat, held vertically. Pull the needle back out by two-thirds of its length, then release it. When released, the needle must fall back onto the seat under its own weight – if not, the nozzle must be renewed.

28 Clean and degrease any new parts using a suitable solvent, then dip the parts in clean test fluid or diesel fuel. If possible, prime the injector body with the fluid or fuel too. Reassemble the injector and tighten the body sections together, not forgetting to fit a new sealing washer (when applicable) between the two halves (**see illustration**).

29 Test the injector on the bench. Note that good results will not be obtained until the injector components are thoroughly coated with oil and any air has been expelled. Be prepared to make adjustments to the opening

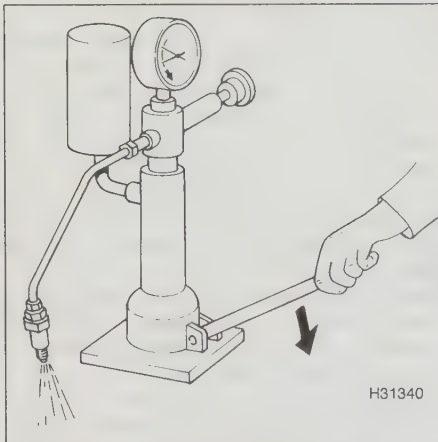


4.28 Assembling a Bosch screw-in pintle injector

A Injector components laid out for assembly
B Inserting the needle into the seat
C Fitting the nozzle into the holder

D Fitting the sleeve
E Fitting the spindle to the spring . . .
F . . . the spring and spindle into the holder . . .

G . . . and the shim on top of the spring
H Fitting the injector body
J Assembled injector – opening pressure (arrowed) is not always marked



4.33a Checking injector spray pattern with an injector tester

pressure if new components have been fitted, or if the injector has seen much service (50 000 miles/80 000 km or more).

Bench-testing



Warning: Never expose the hands, face, or any other part of the body to injector spray: the high working pressure can penetrate the skin, with potentially fatal results. When possible, use injector test fluid rather than fuel for testing. Take precautions to avoid inhaling the vapourised fuel or injector test fluid. Remember that even diesel fuel is inflammable when vaporised.

30 An injector tester will be needed for this work. These are described in Chapter 6. Follow the tester manufacturer's instructions, or if these are not available, use the following general procedure.

31 Connect the injector to the tester. Charge the tester with clean diesel fuel or test fluid, and bleed it. Make sure that the injector spray is safely directed.

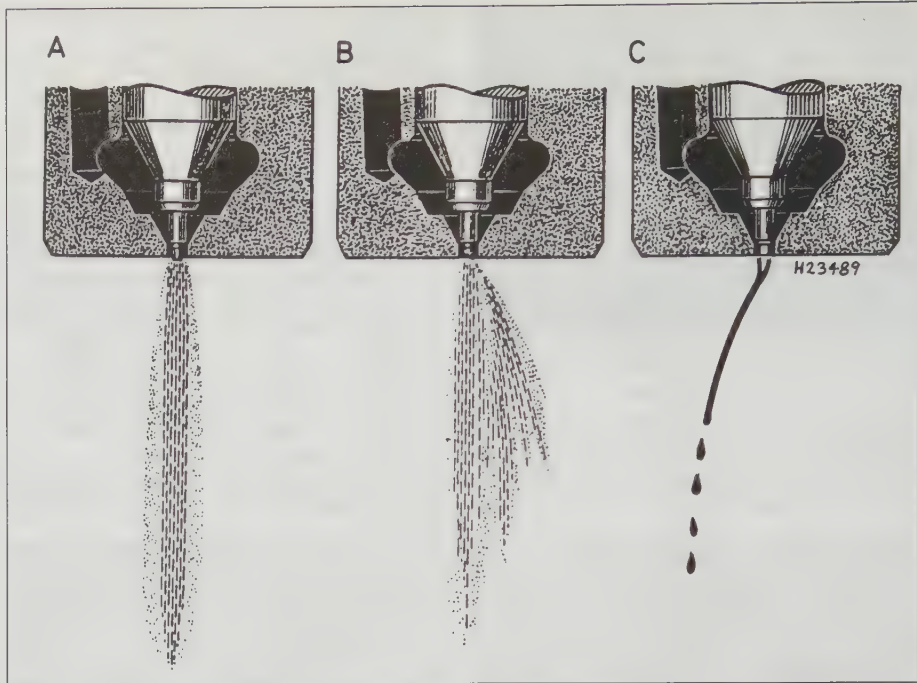
32 If the injector tester has some means of adjusting the flow of test fluid, adjust it to the minimum setting which will still operate the injector satisfactorily.

Spray pattern

33 Shut off the tester pressure gauge. Pump the handle of the tester fairly rapidly (4 to 6 strokes per second) and observe the spray pattern. On pintle injectors, the spray pattern should be even and fan-shaped, free of streaks. The spray must start and stop cleanly, with no drips (see illustrations).

34 On multi-hole injectors, the desired pattern is similar, but obviously there will be gaps corresponding to the intervals between the holes. Hole distribution is not always symmetrical.

35 The Pintaux type injector nozzle (with two holes, found on some Land Rover engines), is a special case. The main hole delivers a central spray of fuel, and the auxiliary one delivers a spray to one side (see illustration).



4.33b Pintle injector spray patterns

A Good - well-defined spray

B Bad - poorly-defined, ragged spray

C Bad - 'hosing'

It should be possible to produce a spray from the auxiliary hole alone by reducing the rate of pumping.

Injector buzz

36 Pump the tester handle more slowly (1 or 2 strokes per second). Listen to the injector: it should buzz while spraying. The buzzing sound is caused by the needle vibrating rapidly against its seat. This vibration is important in atomising the fuel.

Opening (or 'breaking') pressure

37 Observe the pressure gauge on the tester. Slowly depress the tester handle, and note the pressure at which injector spray begins. Specific values are given in Chapter 10. (Sometimes the opening pressure is marked

on the outside of the injector body.) Typical values are as follows:

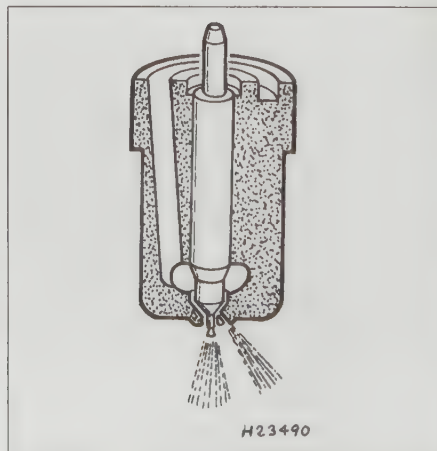
New pintle injector	130 bar
New hole injector	200 bar
Used injector	10 to 20 bar lower than new pressure

Nozzle leakage (dribble)

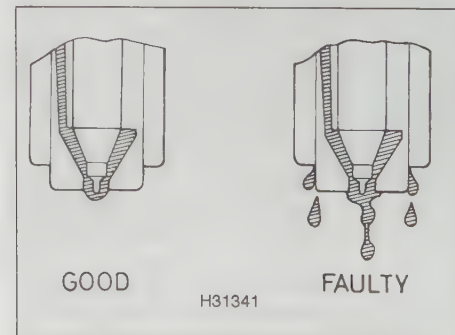
38 Wipe dry the tip of the injector. Bring the pressure on the tester to 10 bar less than the observed opening pressure. Hold the pressure at this value for 20 seconds, and observe the tip of the injector (see illustration). It must not drip fuel, though it may become moist. (Some manufacturers specify slightly different pressures and/or periods for the leak test.)

Back-leakage

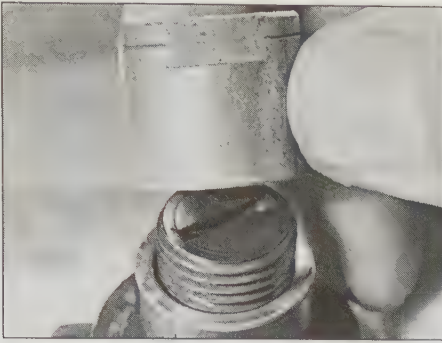
39 In the back-leakage test, the time taken for the injector to lose pressure as a result of internal leakage is measured. A typical specification would be that the pressure drop



4.35 Pintaux injector spray pattern



4.38 Injector nozzle leakage (dribble) test



4.51 Injector pressure-adjustment screw and cap nut

from 100 to 75 bar must take between 10 and 30 seconds. Too rapid a drop shows internal wear in the nozzle, or poor sealing between the injector body halves. (It can also show that the tester itself is worn or leaking, so do not rush to condemn an injector without establishing that the tester is OK.)

40 If there is no back-leakage at all, the needle is sticking in the nozzle, and should be removed for inspection or renewal.

41 Back-leakage can also occur in the form of a spurt of fuel from the leak-off connection at the moment of injection. If this has no effect on injector performance it can be ignored, but if it is bad enough to cause a 'kick' on the tester pressure gauge, the injector should be

stripped for inspection. This fault can cause leakage of fuel from the leak-off pipes in service.

Interpretation of results

42 If the injector has not yet been cleaned, do so now and repeat the tests.

43 A poor spray pattern or a lack of buzzing can usually be corrected by renewing the nozzle. Note, however that it is possible for an injector to perform satisfactorily in service, even though its spray pattern and noise on the bench are suspect. This is particularly true of indirect injection engines, where the swirl chamber characteristics can compensate to some extent for poor spray pattern.

44 Lack of buzzing, accompanied by an excessively wet spray pattern, can be caused by a weak or broken injector spring.

45 An incorrect opening pressure can be adjusted as described later in this Section.

46 A leaking nozzle must be renewed. A nozzle which leaks in service will rapidly become clogged up with carbon.

47 Excessive back-leakage will normally be cured by renewing the nozzle.

Adjustment of opening (or 'breaking') pressure (calibration)

48 After component renewal, or if the opening pressure is incorrect, the injector should be calibrated as follows.

49 Using the injector tester, measure the opening pressure and compare it with that specified by the manufacturer. (Opening pressure is also sometimes stamped on the injector body.)

50 Adjust the pressure to the 'new' value. This is normally done by changing the shim thickness in the injector. Obviously a range of shims will be needed. Increasing shim thickness raises the opening pressure, reducing thickness lowers it. Typically, changing the shim thickness by 0.05 mm will alter the opening pressure by approximately 5 bar.

51 A few injector types have an adjustment screw instead of a shim. After slackening a locknut or cap nut, the screw is tightened to increase opening pressure, or slackened to reduce it (**see illustration**). Tighten the locknut or cap nut without disturbing the adjustment screw position when the opening pressure is correct.

5 Glow plugs – removal, inspection and refitting

Removal

1 Disconnect the battery negative lead.

2 Remove any surrounding components to allow access to the glow plugs.

3 Unscrew the nuts from the glow plug terminals, and where applicable recover the washers. Remove the interconnecting wire(s), and where applicable the feed wire from the top of the glow plugs (**see illustrations**).

4 Unscrew the glow plugs and remove them from the cylinder head (**see illustration**).

Inspection

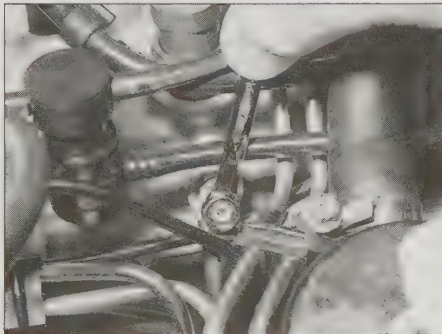
5 Inspect the glow plugs for physical damage. Burnt or eroded glow plug tips can be caused by a bad injector spray pattern. Have the injectors checked if this sort of damage is found.

6 If the glow plugs are in good physical condition, check them as described in Chapter 3, Section 7.

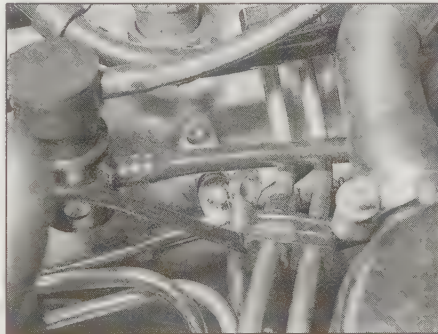
Refitting

7 If new plugs are being fitted, ensure that the correct type plug is used, as recommended by the manufacturer.

8 Refit by reversing the removal operations. Apply a smear of copper-based anti-seize compound to the plug threads, and tighten to the specified torque. Do not overtighten, as this can damage the glow plug element.



5.3a Unscrew the nut ...



5.3b ... and disconnect the feed wire ...



5.3c ... and the interconnecting wire from the glow plug



5.4 Removing a glow plug

Notes

Chapter 9

Fault diagnosis

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1 Introduction

The majority of starting problems on small diesel engines are electrical in origin.

When investigating difficult starting, make sure that the correct starting procedure is understood and is being followed. Some drivers are unaware of the significance of the

preheating warning light; many modern engines are sufficiently forgiving for this not to matter in mild weather, but with the onset of winter, problems begin.

As a rule of thumb, if the engine is difficult to start, but runs well when it has finally got going, the problem is electrical (battery, starter motor or preheating system). If poor performance is combined with difficult starting, the problem is likely to be in the fuel system. The low-pressure (supply) side of the fuel system should be checked before

suspecting the injectors and injection pump. *Normally the pump is the last item to suspect, since (unless it has been tampered with) there is no reason for it to be at fault.*

Bear in mind that most modern diesel engine vehicles with electronic control have a self-diagnosis system which will store details of any faults as fault codes in the electronic control unit memory (see Section 19). If a fault code is present, a warning light will normally be illuminated on the instrument panel to inform the driver.

2 Fault diagnosis charts

Engine turns but will not start (cold)

- ☐ Incorrect use of preheating system
- ☐ Preheating system fault
- ☐ Fuel waxing (in very cold weather)
- ☐ Overfuelling or cold start advance mechanism defective
- ☐ Electronic control system fault (where applicable)

Engine turns but will not start (hot or cold)

- ☐ Low cranking speed
- ☐ Poor compression
- ☐ No fuel in tank
- ☐ Air in fuel system
- ☐ Fuel feed restrictions
- ☐ Fuel contaminated
- ☐ Engine stop solenoid or mechanism defective
- ☐ Major mechanical failure
- ☐ Injection pump internal fault
- ☐ Electronic control system fault (where applicable)

Low cranking speed

- ☐ Inadequate battery capacity
- ☐ Incorrect grade of oil
- ☐ High resistance in starter motor circuit
- ☐ Starter motor internal fault

Engine is difficult to start

- ☐ Incorrect starting procedure
- ☐ Battery or starter motor fault
- ☐ Air in fuel system
- ☐ Fuel feed restriction
- ☐ Fuel lift pump defective
- ☐ Poor compression
- ☐ Valve clearances incorrect
- ☐ Valves sticking
- ☐ Blockage in exhaust system
- ☐ Valve timing incorrect
- ☐ Injector(s) faulty
- ☐ Injection pump timing incorrect
- ☐ Injection pump internal fault
- ☐ Electronic control system fault (where applicable)

Engine starts but stops again

- ☐ Fuel very low in tank
- ☐ Air in fuel system
- ☐ Idle adjustment incorrect
- ☐ Fast idle unit fault
- ☐ Fuel feed restriction
- ☐ Fuel return restriction
- ☐ Air cleaner faulty
- ☐ Blockage in induction system
- ☐ Blockage in exhaust system
- ☐ Electronic control system fault (where applicable)
- ☐ Injector(s) faulty

Engine will not stop when switched off

- ☐ Stop solenoid defective
- ☐ Stop actuator leaking or disconnected (vacuum type)
- ☐ Electronic control system fault (where applicable)

Misfiring/rough idle

- ☐ Air cleaner dirty
- ☐ Blockage in induction system
- ☐ Air in fuel system
- ☐ Fuel feed restriction
- ☐ Valve clearances incorrect
- ☐ Fuel lift pump defective (where applicable)

- ☐ Valve(s) sticking
- ☐ Valve spring(s) weak or broken
- ☐ Poor compression
- ☐ Overheating
- ☐ Injector pipe(s) wrongly connected or wrong type
- ☐ Valve timing incorrect
- ☐ Injector(s) faulty or wrong type
- ☐ Injection pump timing incorrect
- ☐ Injection pump faulty or wrong type
- ☐ Electronic control system fault (where applicable)

Lack of power

- ☐ Accelerator linkage not moving through full travel (cable slack or pedal obstructed)
- ☐ Other pump control linkages sticking or maladjusted
- ☐ Air cleaner dirty
- ☐ Blockage in induction system
- ☐ Air in fuel system
- ☐ Fuel feed restriction
- ☐ Fuel lift pump defective (where applicable)
- ☐ Valve timing incorrect
- ☐ Injection pump timing incorrect
- ☐ Blockage in exhaust system
- ☐ Turbo boost pressure inadequate (where applicable)
- ☐ Valve clearances incorrect
- ☐ Poor compression
- ☐ Injector(s) faulty or wrong type
- ☐ Injection pump faulty or wrong type
- ☐ Electronic control system fault (where applicable)

Fuel consumption excessive

- ☐ External leakage
- ☐ Fuel passing into sump
- ☐ Air cleaner dirty
- ☐ Blockage in induction system
- ☐ Valve clearances incorrect
- ☐ Valve(s) sticking
- ☐ Valve spring(s) weak
- ☐ Flame plug leaking fuel (where applicable)
- ☐ Poor compression
- ☐ Valve timing incorrect
- ☐ Injection pump timing incorrect
- ☐ Injector(s) faulty or wrong type
- ☐ Injection pump faulty or wrong type
- ☐ Electronic control system fault (where applicable)

Engine knocks

- ☐ Air in fuel system
- ☐ Fuel grade incorrect or quality poor
- ☐ Injector(s) faulty or wrong type
- ☐ Valve spring(s) weak or broken
- ☐ Valve(s) sticking
- ☐ Valve clearances incorrect
- ☐ Valve timing incorrect
- ☐ Injection pump timing incorrect
- ☐ Piston protrusion excessive/head gasket thickness inadequate (after repair)
- ☐ Valve recess incorrect (after repair)
- ☐ Piston rings broken or worn
- ☐ Pistons and/or bores worn
- ☐ Crankshaft bearings worn or damaged
- ☐ Small-end bearings worn
- ☐ Camshaft worn
- ☐ Timing gears worn
- ☐ Electronic control system fault (where applicable)

Black smoke in exhaust

- ☐ Air cleaner dirty
- ☐ Blockage in induction system
- ☐ Valve clearances incorrect
- ☐ Poor compression
- ☐ Turbo boost pressure inadequate (where applicable)
- ☐ Blockage in exhaust system
- ☐ Valve timing incorrect
- ☐ Flame plug leaking (where applicable)
- ☐ Injector(s) faulty or wrong type
- ☐ Injection pump timing incorrect
- ☐ Injection pump faulty or wrong type
- ☐ Electronic control system fault (where applicable)

Blue or white smoke in exhaust

- ☐ Engine oil incorrect grade or poor quality
- ☐ Glow plug(s) defective, or control unit faulty (smoke at start-up only)
- ☐ Flame plug leaking (where applicable)
- ☐ Overfuelling device operating after start-up (where applicable)
- ☐ Air cleaner dirty
- ☐ Blockage in induction system
- ☐ Valve timing incorrect
- ☐ Injection pump timing incorrect
- ☐ Injector(s) defective, or heat shields damaged or missing
- ☐ Engine running too cool
- ☐ Oil entering via valve stems
- ☐ Poor compression
- ☐ Head gasket blown
- ☐ Piston rings broken or worn
- ☐ Pistons and/or bores worn
- ☐ Oil consumption excessive
- ☐ External leakage (standing or running)
- ☐ New engine not yet run-in
- ☐ Engine oil incorrect grade or poor quality
- ☐ Oil level too high
- ☐ Crankcase ventilation system obstructed
- ☐ Oil leaking from oil feed pipe into fuel pipe
- ☐ Oil leakage from accessory (vacuum pump, air compressor, etc)
- ☐ Oil cooler leaking into coolant
- ☐ Oil leaking into injection pump (when applicable)
- ☐ Air cleaner dirty
- ☐ Blockage in induction system
- ☐ Cylinder bores glazed
- ☐ Piston rings broken or worn
- ☐ Pistons and/or bores worn
- ☐ Valve stems or guides worn
- ☐ Valve stem oil seals worn
- ☐ Cylinder bores glazed
- ☐ Piston rings broken or worn
- ☐ Pistons and/or bores worn
- ☐ Valve stems or guides worn
- ☐ Valve stem oil seals worn
- ☐ Electronic control system fault (where applicable)

Overheating

- ☐ Coolant leakage
- ☐ Engine oil level too high
- ☐ Electric cooling fan malfunctioning (where applicable)
- ☐ Water pump drivebelt slack or broken
- ☐ Water pump defective
- ☐ Radiator clogged externally
- ☐ Radiator clogged internally
- ☐ Hoses blocked or collapsed
- ☐ Pressure cap defective or incorrect
- ☐ Thermostat defective or incorrect
- ☐ Thermostat missing
- ☐ Air cleaner dirty
- ☐ Blockage in induction system

- ☐ Head gasket blown
- ☐ Cylinder head cracked or warped
- ☐ Valve timing incorrect
- ☐ Injection pump timing incorrect (over-advanced)
- ☐ Injector(s) faulty or wrong type
- ☐ Injection pump faulty or wrong type
- ☐ Electronic control system fault (where applicable)
- ☐ Imminent seizure (piston pick-up)

Crankcase pressure excessive (oil being blown out)

- ☐ Blockage in crankcase ventilation system
- ☐ Leakage in vacuum pump or exhaust
- ☐ Piston rings broken or sticking
- ☐ Pistons or bores worn
- ☐ Head gasket blown

Erratic running

- ☐ Operating temperature incorrect
- ☐ Stop control or accelerator linkages maladjusted or sticking
- ☐ Air cleaner dirty
- ☐ Blockage in induction system
- ☐ Air in fuel system
- ☐ Injector pipe(s) wrongly connected or wrong type
- ☐ Fuel feed restriction
- ☐ Fuel lift pump defective (where applicable)
- ☐ Valve clearances incorrect
- ☐ Valve(s) sticking
- ☐ Valve spring(s) broken or weak
- ☐ Valve timing incorrect
- ☐ Poor compression
- ☐ Injector(s) faulty or wrong type
- ☐ Injection pump mountings loose
- ☐ Injection pump timing incorrect
- ☐ Injection pump faulty or wrong type
- ☐ Electronic control system fault (where applicable)

Vibration

- ☐ Accelerator linkage sticking
- ☐ Engine mountings loose or worn
- ☐ Cooling fan damaged or loose
- ☐ Crankshaft pulley/damper damaged or loose
- ☐ Injector pipe(s) wrongly connected or wrong type
- ☐ Valve(s) sticking
- ☐ Flywheel or (where applicable) flywheel housing loose
- ☐ Poor (uneven) compression

Low oil pressure

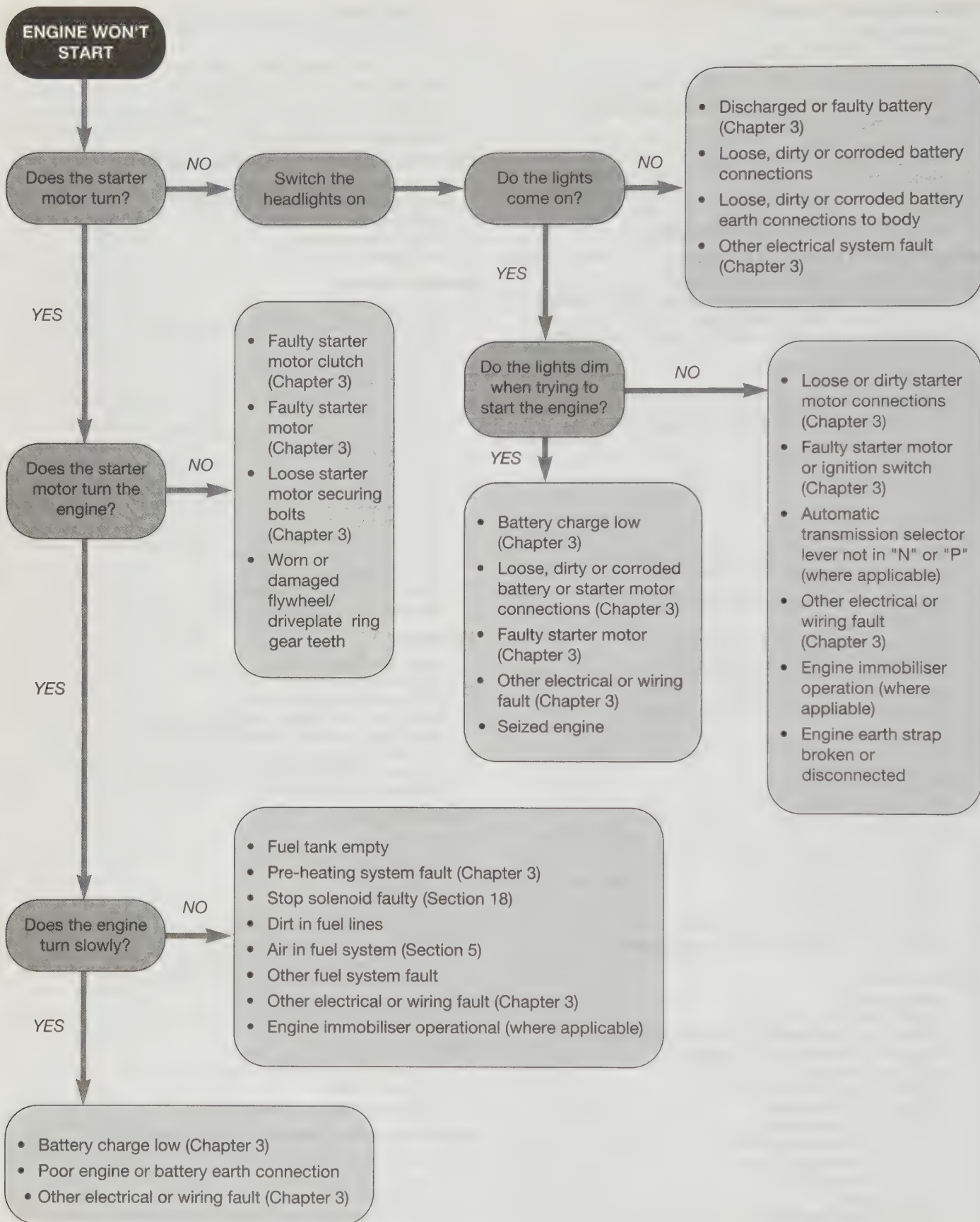
- ☐ Oil level low
- ☐ Oil grade or quality incorrect
- ☐ Oil filter clogged
- ☐ Overheating
- ☐ Oil contaminated
- ☐ Gauge or warning light sender inaccurate
- ☐ Oil pump pick-up strainer clogged
- ☐ Oil pump suction pipe loose or cracked
- ☐ Oil pressure relief valve defective or stuck open
- ☐ Oil pump worn
- ☐ Crankshaft bearings worn

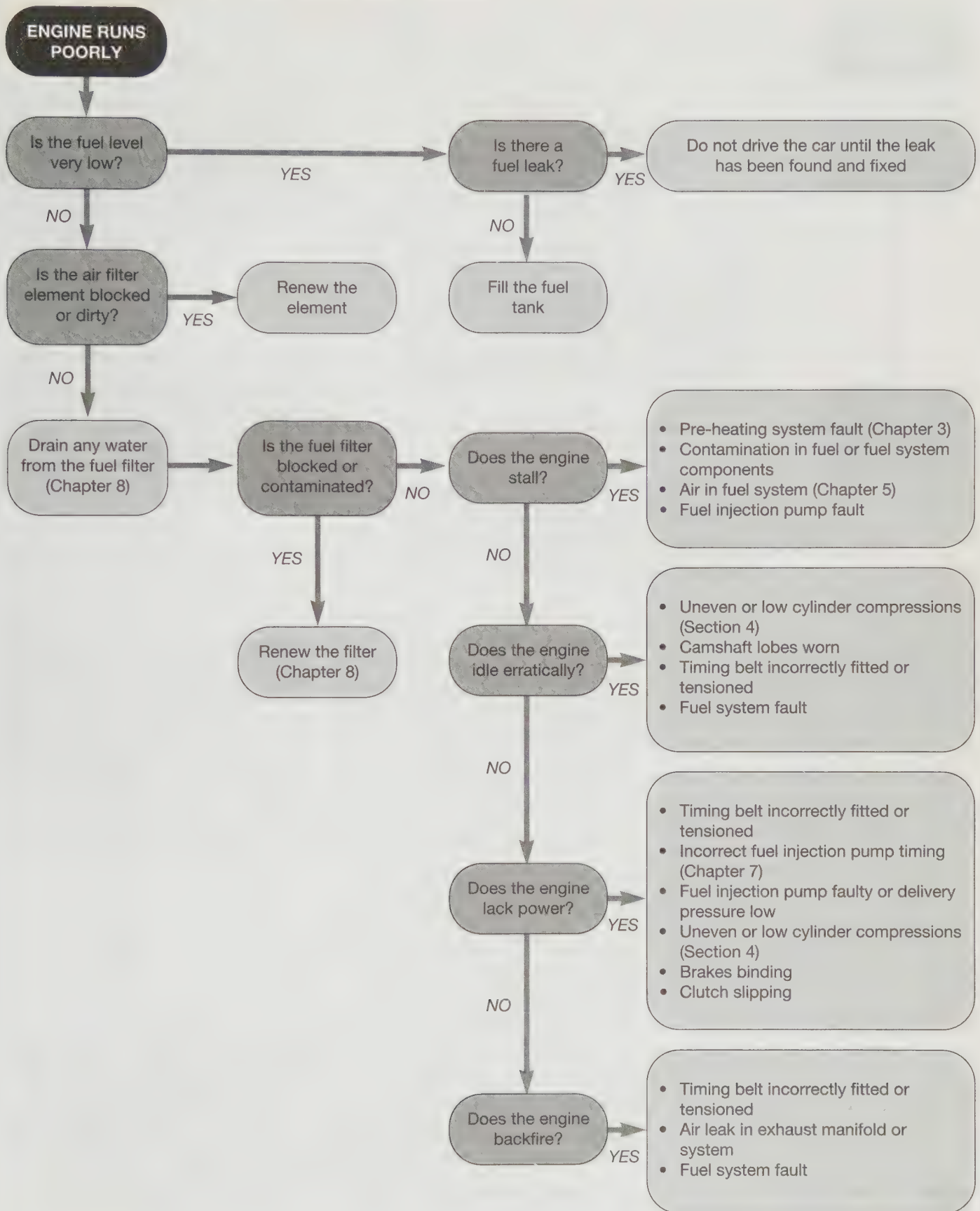
High oil pressure

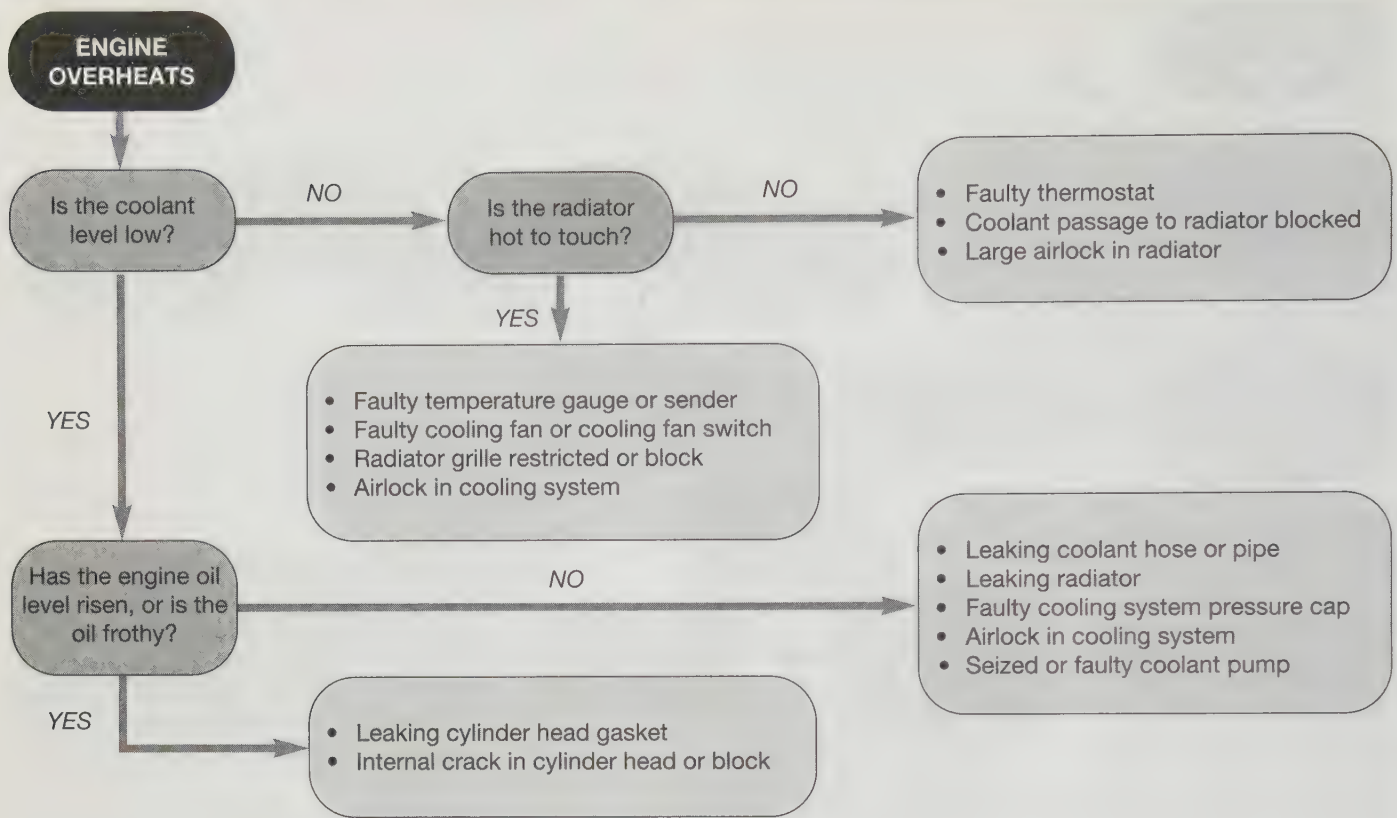
- ☐ Oil grade or quality incorrect
- ☐ Gauge inaccurate
- ☐ Oil pressure relief valve stuck shut

Injector pipe(s) break or split repeatedly

- ☐ Missing or wrongly-located clamps
- ☐ Wrong type or length of pipe
- ☐ Faulty injector
- ☐ Faulty delivery valve







3 Fuel supply system - testing

1 It is necessary to test the fuel supply system if it is suspected that air is being drawn into the fuel, or if there is evidence of a blockage causing fuel starvation.

2 Remember that when a separate fuel lift pump is fitted, the supply lines are under negative pressure between the fuel tank and the lift pump, and under positive pressure from the lift pump to the injection pump. When no separate lift pump is fitted, the supply lines are under negative pressure all the way from the tank to the injection pump. Air can enter at any leaking union, seal, bleed screw or pipe under negative pressure; fuel will not necessarily leak out, even when the engine is stopped.

3 The fuel return system is also important. On pumps where injection timing is affected by transfer pressure, blockage in the return system can show up as poor performance caused by incorrect timing. The fuel return banjo bolt often incorporates a calibrated orifice; if the supply and return bolts are accidentally interchanged, this too will cause problems (see illustration).

Testing for air entry

4 The presence of air in the fuel can be

verified by fitting a piece of transparent hose in the injection pump fuel return line, and running the engine at 2000 to 3000 rpm. If air is being drawn in, bubbles will be visible in the returning fuel. A few bubbles are nothing to worry about, but a continuous stream means trouble. If a return line is fitted at the fuel filter, a similar check can be made there.

5 Further testing requires a hand-operated vacuum pump, with a vacuum gauge.

6 Locate the fuel supply line where it leaves the fuel tank. Either disconnect the line and plug it, or (if a flexible hose is fitted at this point) clamp it with a brake hose clamp or self-locking pliers with protected jaws.

7 Clean around the supply line where it enters the fuel injection pump (or lift pump, if applicable), and disconnect it. Connect the vacuum pump to the line.

Caution: It is important that no dirt is allowed to enter the pump.

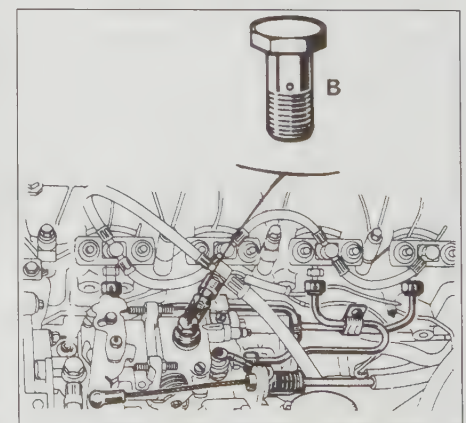
8 Apply vacuum to the line, and watch the gauge. If the gauge falls, air is entering the line somewhere. If the gauge does not fall, air was being drawn in on the tank side of the point where the line is clamped or plugged. Check that the pick-up pipe (stack pipe) is not split.

9 Disconnect the vacuum pump, and reconnect it at the first union in the direction of the fuel tank. (On systems without a lift pump, this will be on the injection pump side of the filter.) Again, take care to clean around the union first. Reapply the vacuum and again

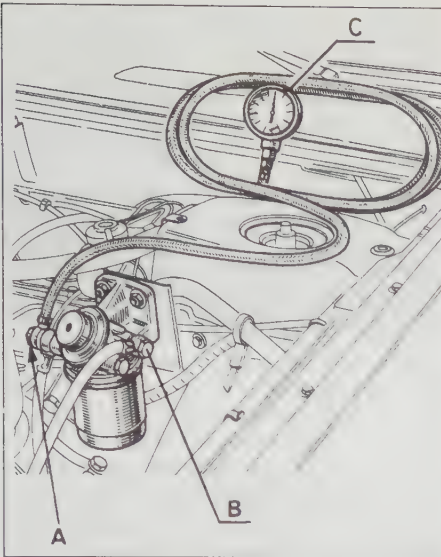
watch the gauge. If the vacuum is held this time, the leak was in the section first tested.

10 If the gauge still falls, disconnect the pump and repeat the test one union nearer the fuel tank. Carry on until the leaking union, section or component is located, then repair and re-test. When a diaphragm type hand-priming pump is fitted, do not overlook this as a possible source of air entry, especially if it has seen much service.

11 Unplug or unclamp the supply line at the tank, and remake the original connections.



3.3 Fuel return banjo bolt (B) with calibrated orifice



3.15 Checking the pressure drop across the fuel filter

A Inlet
B Outlet
C Pressure gauge

Testing for blockage

Systems without a separate lift pump

12 A fuel line vacuum gauge with the necessary adapters will be needed for this test. The gauge range should be approximately 0 to 1 bar.

13 Clean around the fuel pipe union on the outlet (injection pump side) of the fuel filter. Connect the gauge to this union using a T-piece.

Caution: It is important that no dirt is allowed to enter the pump.

14 Run the engine at maximum rpm, and note the gauge reading. Vacuum of 0.2 bar is

acceptable. Any higher reading shows that there is a blockage.

15 Stop the engine. Remake the original fuel line connections on the pump side of the filter, and connect the vacuum gauge to the inlet (tank side) union of the filter (see illustration). Run the engine at maximum rpm again, and note the gauge reading. Vacuum of up to 0.1 bar is acceptable. Any higher reading shows that there is a blockage on the tank side of the filter.

16 The difference between the two gauge readings is caused by the resistance to flow of the fuel filter. If the difference is greater than 0.15 bar, this shows that the fuel filter element is clogged, and should be renewed.

17 A blockage on the tank side of the filter may be caused by one of the following:

- Blocked tank vent or filler cap vent (as applicable).
- Clogged pick-up strainer (if fitted) in tank.
- Tank-to-filter pipe kinked or squashed (external damage).
- Tank-to-filter pipe blocked internally.

18 When testing is complete, stop the engine and remake the original fuel line connections.

Systems with a separate fuel lift pump

19 The principle of testing is the same as described previously for systems without a lift pump, with the difference being that there is negative pressure on the tank side of the lift pump, and positive pressure on the injection pump side (see illustration). The gauge used must therefore have both positive and negative ranges – typically 0 to 1 bar vacuum, and 0 to 2 bars pressure.

4 Poor compression

1 Poor compression may give rise to a number of faults, including difficult starting,

loss of power, misfiring or uneven running and smoke in the exhaust.

2 Before looking for mechanical reasons for compression loss, check that the problem is not on the induction side. A dirty air cleaner or some other blockage in the induction system can restrict air intake to the point where compression suffers.

3 Mechanical reasons for low compression include:

- Incorrect valve clearances.
- Sticking valves.
- Weak or broken valve springs.
- Incorrect valve timing.
- Worn or burnt valve heads and seats.
- Worn valve stems and guides.
- Head gasket blown.
- Piston rings broken or sticking.
- Pistons or bores worn.
- Head gasket thickness incorrect (after rebuild).

4 Compression loss on one cylinder alone can be due to a defective or badly-seated glow plug, or a leaking injector sealing washer. Some engines also have a cylinder head plug (for the insertion of a dial test indicator probe when determining TDC), and this should not be overlooked as a possible source of leaks.

5 Compression loss on two adjacent cylinders is almost certainly due to the head gasket blowing between them. Sometimes the fault will be corrected by renewing the gasket, but a blown gasket can also be an indication that the cylinder head itself is warped. Always check the head mating face for distortion when renewing the gasket. On wet-liner engines, also check the liner protrusion.

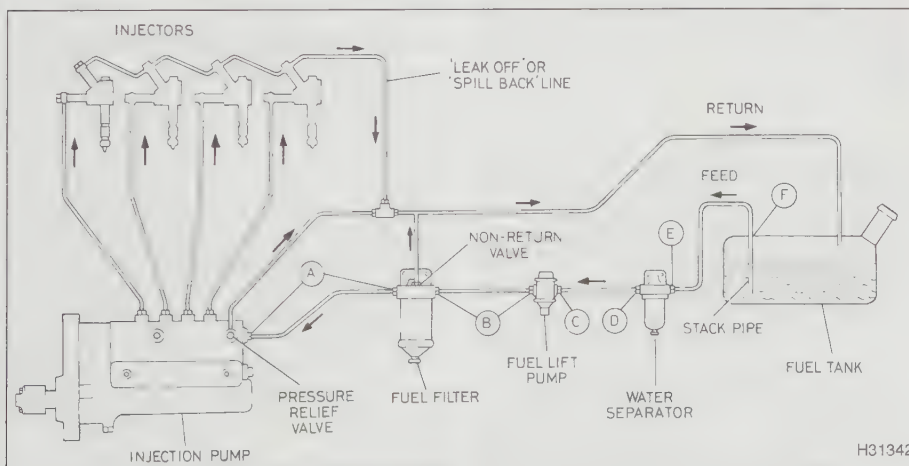
Compression test

6 A compression tester specifically intended for diesel engines must be used, because of the higher pressures involved compared to a petrol engine – see Chapter 6. The tester is connected to an adapter which screws into the glow plug or injector hole. Normally, sealing washers must be used on both sides of the adapter.

7 Unless specific instructions to the contrary are supplied with the tester, observe the following points:

- The battery must be in a good state of charge, the air cleaner element must be clean, and the engine should be at normal operating temperature.
- All the injectors or glow plugs should be removed before starting the test. If removing the injectors, also remove their heat shields (when fitted), otherwise they may be blown out.
- The stop control lever on the injection pump must be operated, or the stop solenoid disconnected, to prevent the engine from running, or fuel from being discharged.

8 There is no need to hold the accelerator pedal down during the test, because the diesel engine air inlet is not throttled. (There



3.19 Fuel supply checking points – systems with a separate lift pump

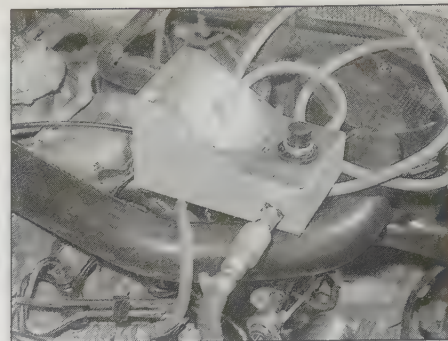
- | | | |
|---|-----------------------------------|----------------------------------|
| A Injection pump inlet/filter outlet (lift pump pressure) | C Lift pump inlet (vacuum) | E Water separator inlet (vacuum) |
| B Filter inlet/lift pump outlet (lift pump pressure) | D Water separator outlet (vacuum) | F Fuel tank outlet (vacuum) |



4.13a Leakdown test adapter being fitted to a glow plug hole



4.13b Whistle fitted to test adapter to find TDC



4.15 Leakdown tester in use

are rare exceptions to this case, when a throttle valve is used to produce vacuum for servo or governor operation – for example, early Land Rovers.)

9 The actual compression pressures measured are not so important as the balance between cylinders. Typical values at cranking speeds are:

Good condition	25 to 30 bar
Minimum	18 bar
Maximum difference between cylinders	5 bar

10 The cause of poor compression is less easy to establish on a diesel engine than on a petrol one. The effect of introducing oil into the cylinders ('wet' testing) is not conclusive, because there is a risk that the oil will sit in the bowl in the piston crown (direct injection engines) or in the swirl chamber (indirect injection engines), instead of passing to the piston rings.

Leakdown test

11 A leakdown test measures the rate at which compressed air fed into the cylinder is lost. It is an alternative to a compression test, and in many ways is better, since it provides easy identification of where pressure loss is occurring (piston ring, valves or head gasket). However, it does require a source of compressed air.

Caution: Before beginning the test, remove the cooling system pressure cap.

This is necessary because if there is a leak into the cooling system, the introduction of compressed air may damage the radiator. Similarly, it is advisable to remove the dipstick or the oil filler cap, to prevent excessive crankcase pressurisation.

12 Connect the tester to a compressed air line, and adjust the reading to 100% as instructed by the manufacturer.

13 Remove the glow plugs or injectors, and screw the appropriate adapter into a glow plug or injector hole. Fit the whistle to the adapter, and turn the crankshaft. When the whistle begins to sound, the piston in question is rising on compression. When the whistle stops, TDC has been reached (see illustrations).

14 Engage a gear and apply the handbrake

to stop the engine turning. Remove the whistle and connect the tester to the adapter. Note the tester reading, which indicates the rate at which the air escapes. Repeat the test on the other cylinders.

15 The tester reading is in the form of a percentage, where 100% is perfect. Readings of 80% or better are to be expected from an engine in good condition. The actual reading is less important than the balance between cylinders, which should be within 5% (see illustration).

16 The areas from which escaping air emerges show where a fault lies as follows:

Air escaping from	Probable cause
Oil filler cap or dipstick tube	Worn piston rings or cylinder bores
Exhaust pipe	Worn or burnt exhaust valve
Air cleaner/inlet manifold	Worn or burnt inlet valve
Cooling system	Blown head gasket or cracked cylinder head

17 Bear in mind that if the head gasket is blown between two adjacent cylinders, air escaping from the cylinder under test may emerge via an open valve in the cylinder adjacent.

5 Air in fuel system

1 The diesel engine will not run at all, or at best will run erratically, if there is air in the fuel lines. If the fuel tank has been allowed to run dry, or after operations in which the fuel supply lines have been opened, the fuel system must be bled before the engine will run. Methods of bleeding are given in Chapter 8, Section 2.

2 Air will also enter the fuel lines through any leaking joint or seal, since the supply side is under negative pressure all the time that the engine is running. For testing procedures, see Section 3.

6 Fuel feed restricted

1 Restriction in the fuel feed from the tank to the pump may be caused by any one of the following faults:

- Fuel filter blocked.
- Tank vent blocked.
- Feed pipe blocked or collapsed.
- Fuel waxing (in very cold weather).

2 Testing of the fuel supply system is covered in Section 3.

Fuel waxing

3 In the case of fuel waxing, the wax normally builds up first in the filter. If the filter can be warmed, this will often allow the engine to run. Only in exceptionally severe weather will waxing prevent winter-grade fuel from being pumped out of the tank. See Chapter 2 for more details.

Caution: Do not use a naked flame for this.

Microbiological contamination

4 Under certain conditions, it is possible for micro-organisms to colonise the fuel tank and supply lines. These micro-organisms produce a black sludge or slime, which can block the filter and cause corrosion on metal parts. The problem normally shows up first as unexpected blockage of the filter.

5 If such contamination is found, drain the fuel tank, and discard the drained fuel. Flush the tank and fuel lines with clean fuel, and renew the fuel filter; in bad cases, steam-clean the tank as well. If there is evidence that the contamination has passed the fuel filter, have the injection pump cleaned by a specialist.

6 Further trouble may be avoided by only using fuel from reputable outlets with a high turnover. Proprietary additives are also available to inhibit the growth of micro-organisms in storage tanks or in the vehicle fuel tank.

7 Lack of power

1 Complaints of lack of power are not always justified. If necessary, perform a road or dynamometer test to verify the condition. Even if power is down, the complaint is not necessarily due to an engine or injection system fault.

2 Before commencing detailed investigation, check that the accelerator linkage is moving through its full travel. Also make sure that an apparent power loss is not caused by items such as binding brakes, under-inflated tyres, overloading of the vehicle, or some particular feature of operation.

8 Turbo-boost pressure inadequate

1 If boost pressure is low, power will be down, and too much fuel may be delivered at high engine speeds (depending on the method of pump control). Possible reasons for low boost pressure include:

- a) *Air cleaner dirty.*
- b) *Leaks in induction system.*
- c) *Blockage in exhaust system.*
- d) *Turbo control fault (wastegate or actuator).*
- e) *Turbo mechanical fault.*

2 Refer to Chapter 4, Section 3 for details of turbocharger boost pressure checking.

9 Fuel consumption excessive

Complaints of excessive fuel consumption, as with lack of power, may not mean that a fault exists. If the complaint is justified and there are no obvious fuel leaks, check the same external factors as for lack of power (Section 7) before turning to the engine and injection system.

10 Fuel in sump

1 If fuel oil is found to be diluting the engine oil in the sump, this may have arrived in one or more of the following ways:

- a) *Down the cylinder bores, especially when the engine is cold.*
- b) *Through a leaking fuel lift pump diaphragm (where applicable).*
- c) *Through leaking injection pump seals, when these communicate with the timing case.*

2 Fuel contamination of the oil can be detected by smell, and in bad cases, by an obvious reduction in viscosity.

11 Knocking caused by injector fault

1 A faulty injector which is causing knocking noises can be identified as follows.

2 Clean around the injector fuel pipe unions, then run the engine at a fast idle so that the knock can be heard. Using a suitable spanner, slacken and retighten each injector in turn. (Cover the union with a piece of rag to absorb the fuel which will spray out.)

3 When the union supplying the defective injector is slackened, the knock will disappear. Stop the engine and remove the injector for inspection (see Chapter 8, Section 4).

12 Excessive exhaust smoke

1 When investigating a complaint of excessive exhaust smoke, check first (by means of a dynamometer or road test) that the smoke is still excessive when the engine has reached normal operating temperature. A cold engine may produce some blue or white smoke until it has warmed up; this is not necessarily a fault.

2 Black smoke is produced by incomplete combustion of the fuel in such a way that carbon particles (soot) are formed. Incomplete combustion shows that there is a lack of oxygen, either because too much fuel is being delivered, or because not enough air is being drawn into the cylinders. A dirty air cleaner is an obvious cause of air starvation; incorrect valve clearances (where applicable) should also be considered. Combustion may also be incomplete because the injection timing is incorrect (too far retarded), or because the injector spray pattern is poor.

3 Blue smoke is produced either by incomplete combustion of the fuel, or by burning engine (sump) oil. This type of incomplete combustion may be caused by incorrect injection timing (too far advanced), by defective injectors, or by damaged or missing injector heat shields.

4 All engines burn a certain amount of engine oil, especially when cold, but if enough is being burnt to cause excessive exhaust smoke, this suggests that there is a significant degree of wear or some other problem.

5 White smoke (not to be confused with steam) is produced by unburnt or partially-burnt fuel appearing in the exhaust gases. Some white smoke is normal during and immediately after start-up, especially in cold conditions. Excessive amounts of white smoke can be caused by a preheating system fault, by incorrect injection pump timing, or by too much fuel being delivered by the injection pump (overfuelling device malfunctioning). The use of poor quality fuel with a low cetane

number, and thus a long ignition delay, can also increase emissions of white smoke.

6 Accurate measurement of exhaust smoke requires the use of some kind of smoke meter; these are described in Chapter 6.

13 Oil entering the engine via valve stems

1 Excessive oil consumption due to oil passing down the valve stems can have three causes:

- a) *Valve stem wear.*
- b) *Valve guide wear.*
- c) *Valve stem oil seal wear.*

2 In the first two cases, the cylinder head must be removed and dismantled so that the valves and guides can be inspected and measured for wear.

3 In the case of worn valve stem oil seals, on some engines, these can be renewed without removing the head. Whether or not this is worthwhile will depend on how worn the valve stems are.

14 Oil consumption excessive

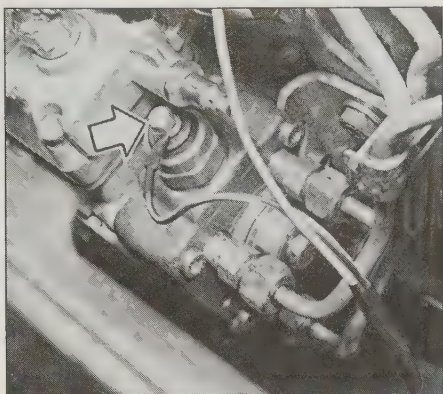
When investigating complaints of excessive oil consumption, make sure that the correct level-checking procedure is being followed. If insufficient time is allowed for the oil to drain down after stopping the engine, or if the level is checked while the vehicle is standing on a slope, a false low reading may result. The unnecessary topping-up which follows may itself cause increased oil consumption, as a result of the level being too high.

15 Cylinder bore glazing

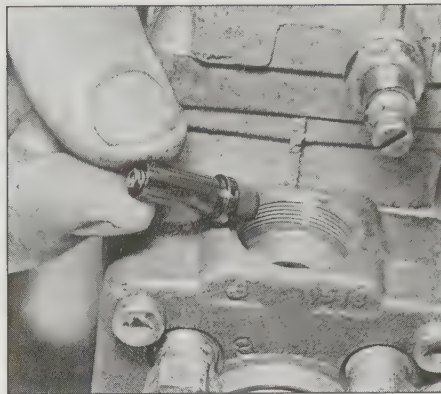
Engines which spend long periods idling can suffer from glazing of the cylinder bores, leading to high oil consumption, even though no significant wear has taken place. The same effect can be produced by incorrect running-in procedures, or by the use of the incorrect grade of oil during running-in. The remedy is to remove the pistons, deglaze the bores with a hone or 'glaze buster' tool, and to fit new piston rings.

16 Overheating

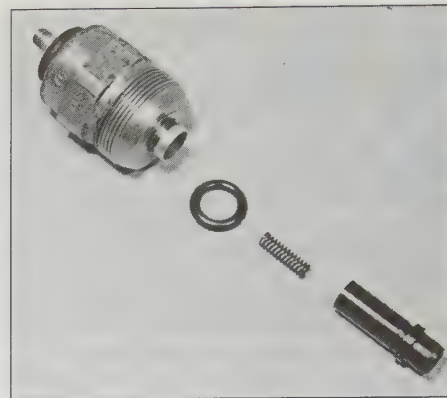
1 Complaints of overheating should first be verified, if they are based only on gauge readings, and not on more definite symptoms. Road-test the vehicle, and use a thermometer



18.3 Stop solenoid wire secured by nut (arrowed)



18.5a Removing the stop solenoid plunger from the pump



18.5b Stop solenoid components

of known accuracy to measure the temperature of the coolant in the radiator or expansion tank when the gauge shows that overheating is taking place.



Warning: Take care to avoid scalding when removing the coolant filler cap on a hot engine.

2 Sometimes the thermostat is removed if it is suspected of being the cause of overheating. If the thermostat is of the bypass-blanking type, this will actually make matters worse, since removing the thermostat increases coolant flow through the bypass, at the expense of flow through the radiator. **Do not** run an engine without the thermostat fitted if it is of this type.

17 Oil contamination

1 Oil contamination falls into three categories: dirt, sludge and dilution.

2 **Dirt** or soot builds up in the oil in normal operation, and is not a problem if regular oil and filter changes are carried out. If it gets to the stage where it is causing low oil pressure, change the oil and filter immediately.

3 **Sludge** occurs when inferior grades of oil are used, or when regular oil changing has been neglected; it is more likely to occur on engines which rarely reach optimum operating temperature. If sludge is found when draining, a flushing oil may be used if the engine manufacturer allows it.

Caution: Some engine manufacturers – for example Renault – forbid the use of flushing oil, because it cannot all be drained afterwards.

The engine should then be refilled with fresh oil of the correct grade, and a new oil filter be fitted.

4 Dilution is of two kinds: fuel or water (coolant). In either case, if the dilution is bad enough, the engine oil level will appear to rise

with use. The routes by which fuel may get into the sump are explained in Section 10.

5 Coolant dilution of the oil is indicated by the 'mayonnaise' appearance of the oil-and-water mixture. Sometimes oil will also appear in the coolant. Possible reasons are:

- a) Blown head gasket.
- b) Cracked or porous cylinder head or block.
- c) Cylinder liner seal failure (on wet-liner engines).
- d) Leaking oil-to-coolant oil cooler (when fitted).

6 With either type of dilution, the cause must be dealt with, and the oil and filter changed.

18 Engine stop (fuel cut-off) solenoid – emergency repair

1 Most small diesel engines have a solenoid valve for cutting off the supply of fuel to the high-pressure side of the injection pump when the 'ignition' is switched off. If the solenoid fails electrically or mechanically so that its plunger is in the 'shut' position, the engine will not run. (One possible reason for such a failure is that the 'ignition' has been switched off while the engine speed is still high. In such a case, the plunger will be sucked onto its seat with considerable force, and may jam.)

2 Should the valve fail on the road and a spare not be immediately available, the following procedure will serve to get the engine running again.

Caution: It is important that no dirt is allowed to enter the injection pump, via the solenoid hole.

3 With the 'ignition' off, disconnect the wire from the solenoid, and thoroughly clean around the solenoid where it screws into the pump (see illustration).

4 Unscrew the solenoid and remove it. If a hand-priming pump is fitted, operate the pump a few times while lifting out the

solenoid, to wash away any particles of dirt. Do not lose the sealing washer.

5 Remove the plunger from the solenoid (or from the recess in the pump, if it is stuck inside). Refit the solenoid body, making sure the sealing washer is in place, again operating the priming pump at the same time to flush away dirt (see illustrations).

6 Tape up the end of the solenoid wire so that it cannot touch bare metal.

7 The engine will now start and run as usual, but it will not stop when the 'ignition' is switched off: it will be necessary to use the manual stop lever (if fitted) on the injection pump, or to stall the engine in gear.

8 Fit a new solenoid and sealing washer at the earliest opportunity.

19 Reading fault codes

Most modern diesel engines with electronic diesel engine control have a self-diagnostic system. If a fault occurs in any of the system sensors or actuators, this is recognised by the electronic control unit (ECU), which stores an appropriate fault code in its memory.

If a sensor or actuator is faulty, the ECU will usually substitute an 'emergency' value in place of the signal normally associated with the relevant sensor or actuator. This will enable the engine to carry on operating, albeit with reduced performance and efficiency. This situation is often referred to as 'limp home' mode.

If a fault code (or codes) is recorded, the ECU will usually illuminate an engine warning light on the instrument panel to inform the driver that there is a problem. The warning light will normally extinguish once the fault code has been read.

To read fault codes, a suitable fault code reader will be required. A diagnostic connector is provided in the vehicle wiring loom, and a fault code reader can be connected via an appropriate adapter harness.

Chapter 10

Maintenance and repair data

Special notes concerning the use of this Chapter

The layout of this Chapter has been designed for the easiest possible usage, and is therefore generally self-explanatory. However, the following notes should serve to clarify some of the slightly less-obvious aspects of the data, and should be read before consulting the main part of this Chapter.

Valve clearances

These are specified with the engine **COLD** unless otherwise stated.

Brakes – minimum friction material thickness

Where this is not quoted by the manufacturers, it is suggested that the following is used for general guidance.

Disc brake pads should be renewed if the *friction material* thickness is less than 1.5 mm, or if it will reach this state before the next service is due.

Drum brake shoes should similarly be renewed if the friction material thickness is less than 2.0 mm for *bonded* shoe linings, or is within 1.0 mm of the rivet heads for *riveted* shoe linings.

Tyres

Note: Pressures for compact/space saver spare tyres are not quoted.

Tyre pressures are quoted **COLD**, with the vehicle **UNLADEN**, and are typical examples only. Space considerations prevent the inclusion of all possible vehicle type/tyre size/loading combinations. Always follow the manufacturer's recommendations for correct tyre pressures wherever possible. With regard to tyre sizes, these do not generally include the relevant speed/load rating. It is therefore important to refer to the manufacturer's or a tyre specialist's recommendations regarding this aspect, especially for light commercial vehicles.

Wheel alignment/suspension geometry

Figures are generally quoted with the vehicle **UNLADEN**, unless otherwise specified. Figures quoted are for both sides of the vehicle in total, unless stated otherwise. Certain vehicles, in particular those produced by Renault and Ford are set at specific vehicle ride heights, and figures quoted are therefore nominal values only.

Torque wrench settings

The correct assembly of certain cylinder heads, main bearings and wheel hubs often depends on special procedures being strictly adhered to. When using the torque wrench settings given for these items, it is recommended that reference is made to the appropriate manufacturer's information, or the relevant *Haynes Service and Repair Manual*, for further details of any such special procedures. It should be noted that new bolts or nuts should be used as specified by the manufacturer, especially where angular torque tightening methods are used. Note that in some cases, certain bolts fitted to the cylinder head are required to be tightened 'hand-tight'. This equates to a torque wrench setting of approximately 25 Nm. Take special note of any requirements regarding cylinder head bolt types, so that the appropriate torque wrench setting is used. Reference is made to *Torx*, *splined*, *hex (hexagon)* and *Allen* type bolts, and it is vital to use the correct setting according to type (**see illustration**).

Illustrations

These are provided to clearly show the relevant cylinder head bolt/nut tightening sequence, and valve positions. The location of the engine flywheel is clearly visible to aid correct identification of the cylinder locations. The valve *head* positions are indicated, rather than the locations of the adjustment points (eg, rocker arm adjusters).

Information not available

Where the relevant technical data is not quoted by the vehicle manufacturer, this is indicated by a dash (-). A dash may also show that the particular item of data is not applicable to the model in question.

Abbreviations used in this Chapter

Most abbreviations are well-known, and will therefore be familiar to the user of this Chapter. The following list is provided to explain some of the less-familiar abbreviations, although it is stressed that this is a typical selection rather than a comprehensive list

ABS	=	Anti-lock braking system
A/C	=	Air conditioning
AT	=	Automatic transmission
DI	=	Direct injection
EDC	=	Electronic diesel control
FoG	=	Ford of Germany
IDI	=	Indirect injection
IRS	=	Independent rear suspension
L	=	Laden
MT	=	Manual transmission
MY	=	Model year
N/A	=	Not adjustable
O/D	=	Overdrive
OHB	=	Owner's handbook
PAS	=	Power-assisted steering
TWS	=	Torque wrench setting
U/L	=	Unladen
>	=	Greater than
<	=	Less than

Rover vehicles

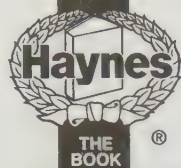
The Section covering this range also incorporates data on vehicles originally manufactured under the **AUSTIN ROVER** or **BRITISH LEYLAND** marque names, including Austin, Morris and Rover.

Vauxhall/Opel vehicles

The section covering this range also incorporates data on vehicles originally manufactured under the **BEDFORD** marque name.



Cylinder head bolt types



ALFA ROMEO

	33 1.8 TD Intercooler 1990 to 1993	145 / 146 1.9 TD 1994 to 1998	75 2.0 TD 1985 to 1992	75 2.4 TD 1988 to 1992
Engine				
Engine type/code.....	VM96A OHV 62kW	AR67501 SOHC Turbo 66kW	VM80A OHV Turbo 70kW	VM81A OHV Turbo 81kW
Capacity (cm ³) / cylinders.....	1779 / 3	1929 / 4	1995 / 4	2393 / 4
Compression ration / pressurebar	22.2 / _	19.2 /	22.0 /	22.0 / ≥21.5
Torque outputNm	0	186	0	0
Oil pressureidle [running] bar	[4.0 to 5.5 @ 4000]	[3.5]	[3.4 to 5.9 @ 4000]	0.5 [3.4 to 5.9]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.30	0.3 ± 0.05	0.30	0.30
- exhaust (mm)	0.30	0.35 ± 0.05	0.30	0.30
Injection order.....	1-3-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	-	-	-	-
Cooling system				
Thermostat opening temperature°C	81 to 85	83	-	80
Radiator cap pressurebar	0.88 to 1.08	1.0 ± 0.1	-	1.1
Fuel system				
Idle speedrpm	875 to 925	900 ± 20	825 ± 25	800 to 850
Maximum (no load) speedrpm	4000	4870 to 5070	4800 to 4830	4800
Smoke test/opacityM ⁻¹ %	2.0	2.0	2.0	2.0
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	1.00 to 1.03 [8]	0.8	0.97 to 0.97	0.78 to 0.80
Crankshaft positionmm [°]	TDC	TDC	TDC	TDC
Turbo type / ref / pressurebar	-	IHI 1.1 to 1.2 bar	-	-
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VE3/10 FL353	VER 0460 494 304	VE 4/9	VE 4/10F 0460 404 042
Injector Make / type.....	Bosch	Bosch	Bosch	Bosch
Injector part no.....	0434 250 125	0 432 217 211	0 432 297 047	0 432 297 047
Injection type.....	Indirect VE	Indirect VER	Indirect	Indirect VE4/10
Injection opening pressure, New [used]...bar	150	150 to 158 [130 to 138]	155 [140]	150 [135]
Glow plugs				
Maker	Bosch/Champion	Beru/Bosch/Champion	Bosch/Champion	Bosch/Champion
Type	0250 201 012 / CH70	663 MJ / 0 250 201 005 / CH163	0 250 201 012 / CH70	0 250 201 012 / CH70
Nominal ratingV/A	11 /	11 / 14	11 /	11 / 13
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.5	1.5	1.5
Rear.....mm	1.0	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size	175/70x13	175/65x14: 185/60x14	-	185/70x14
- Estate / Van.....Size	175/70x13	-	-	-
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 1.8	2.3 / 2.1	-	2.1 / 2.1
- Estate / Vanbar	2.2 / 1.8	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-2 ± 2	-2.5 ± 1.0	-2.0 ± 1.0	0.0 to -2.0
Camber	-1°55' ± 30'	-50' ± 20'	-0°30' ± 30'	-30' ± 30'
Castor	1° ± 30'	3°20' ± 30'	3°30' ± 30'	4° ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 25']	4.0 ± 2.0	-	[0° ± 10']
Camber	0° ± 25'	-1° ± 15'	-	0° ± 30'



ALFA ROMEO

	33 1.8 TD Intercooler 1990 to 1993	45 / 146 1.9 TD 1994 to 1998	75 2.0 TD 1985 to 1992	75 2.4 TD 1988 to 1992
Torque wrench settings				
Cylinder head - stage 1	Nm 29 ± 5	100	29	29
- stage 2	Nm + 50°	+ 90°	+ 50°	+ 50°
- stage 3	Nm + 50° ¹	+ 90°	+ 50° ¹	+ 50° ¹
- stage 4	Nm -	M8: 30	-	-
- stage 5	Nm -	-	-	-
- stage 6	Nm -	-	-	-
Big-end bearings	Nm 79.4 to 84.3 N	25 + 50° N	42, 85 N	40, 80 N
Main bearings	Nm 44.1 to 49.0	55, 110	-	-
Crankshaft pulley bolt	Nm 108	190	150	150
Camshaft pulley bolt	Nm -	110	-	-
Flywheel [driveplate] bolt	Nm 107.8	130	108	108
Front hubs	Nm 226 to 275	275	WSM	WSM
Rear hubs	Nm 265 to 324	275	280	280
Wheel nuts / bolts	Nm 80	100	98	98
Glow plugs	Nm 22.5 to 24.5	15	-	-
Clutch pressure plate bolts	Nm 20	22	-	-
Injection pump sprocket	Nm 88.2	50	88	88
Injectors	Nm 24.5 to 29.4	50	27	27
Injection pump mounting bolts	Nm 29.4 to 31.3	25	-	-
Injector pipe unions	Nm 14.7 to 19.6	30	20	20
Capacities				
Engine oil & filter	litres 5.25	5.0	6.0	6.0
Gearbox	litres 2.6	2.4	2.1	2.1
Automatic transmission	litres -	-	-	-
Final drive	litres WT	WT	WT	WT
Cooling system	litres 8.8	8.9	-	10.0
Fuel tank	litres 50	-	-	50

Notes

33 1.8 TD Intercooler 1990 to 1993

¹Warm up, allow to cool, + 30°
outside rows [b]: + 88 Nm

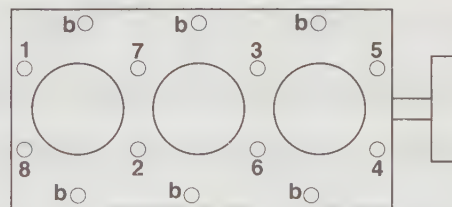
145 / 146 1.9 TD 1994 to 1998

75 2.0 TD 1985 to 1992

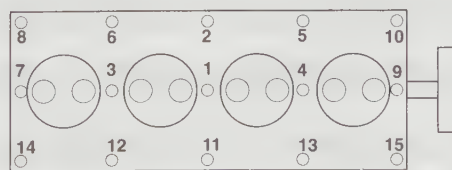
¹Warm up, allow to cool, + 30°
outside row [b]: + 80 Nm

75 2.4 TD 1988 to 1992

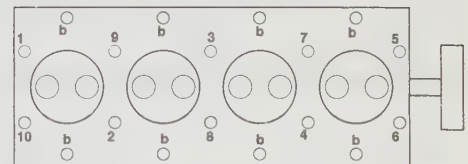
¹Warm up, allow to cool, + 30°
outside row [b]: + 80 Nm



H31305

1779 cm³

H31303

1929 cm³

H31304

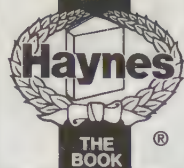
1995 cm³ / 2393 cm³

- Not applicable, or information not available



ALFA ROMEO

	155 2.0 TD 1993 to 1997	156 2.4 JTD 1998 to 2000	164 2.5 TD 1990 to 1994	
Engine				
Engine type/code.....	AR67501 SOHC Turbo 66kW	AR32501 SOHC 100kW	VM84A Turbo 86kW	
Capacity (cm ³) / cylinders.....	1929 / 4	2387 / 5	2495 / 4	
Compression ration / pressurebar	19.2 /	18.45 /	22.0 /	
Torque outputNm	0	224	258	
Oil pressureidle [running] bar	[3.4 to 3.9]	0.2 to 0.4 [2.9 to 3.1]	0.98	
Oil temperature°C	80	80	90	
Valve clearances - inlet (mm)	0.30 ± 0.05	0.30 ± 0.05	0.30	
- exhaust (mm)	0.35 ± 0.05	0.35 ± 0.05	0.30	
Injection order.....	1-3-4-2	1-2-4-5-3	1-3-4-2	
No. 1 cylinder position.....	—	TCE	—	
Cooling system				
Thermostat opening temperature°C	—	85 to 89	81 to 85	
Radiator cap pressurebar	—	0.98 ± 0.1	0.6 to 0.8	
Fuel system				
Idle speedrpm	850 to 950	830 ± 30	875 to 925	
Maximum (no load) speedrpm	4950 to 5050	—	4200	
Smoke test/opacityM ⁻¹ %	1.82	2.5	2.5	
Static timing method.....	Plunger travel	Refer to wsm	Dial gauge	
Timing dimension.....mm	—	—	1.0	
Crankshaft positionmm [°]	—	—	TDC	
Turbo type / ref / pressurebar	0.8 bar @ 2400 rpm	Garrett VNT25	—	
Injection pump make	Bosch	Bosch	Bosch	
Injection pump part no.....	VER 466 0460 494 304	—	VE4/10F2100L269	
Injector Make / type.....	Bosch	—	Bosch	
Injector part no.....	0 432 217 211	—	KB258 S4/4	
Injection type.....	Indirect VER	EDC 15C Common rail	VE	
Injection opening pressure, New [used]...bar	—	1350	147 155 [127]	
Glow plugs				
Maker	Bosch/Champion	Champion	Bosch	
Type	0 250 201 019 / CH68	CH166	0250 201 012	
Nominal rating.....V/A	11 / 13	12 /	11 / 13	
Brakes				
minimum friction material thickness				
Front.....mm	1.5	—	1.0	
Rear.....mm	1.5	—	1.0	
Tyres - Saloon / Hatch.....Size	—	205/55x16	185/65x15: 195/60x15:195/65x15	
- Estate / Van.....Size	—	—	—	
Pressure - front / rear - Saloon / Hatch...bar	—	2.2 / 2.2	2.2 / 2.0	
- Estate / Vanbar	—	—	—	
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.0 ± 1.0	2.0 ± 1.0	0 ± 1.0	
Camber	-0°20'	-0°42' ± 20'	-1°40' ± 20'	
Castor	3°30'	3°55' ± 30'	2°30' ± 20'	
King pin inclination.....	11°30'	—	—	
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	—	3.1 ± 1.0	3.0 ± 1.0	
Camber	—	-0°53' ± 20'	-15' ± 20'	



ALFA ROMEO

	155 2.0 TD 1993 to 1997	156 2.4 JTD 1998 to 2000	164 2.5 TD 1990 to 1994	
Torque wrench settings				
Cylinder head - stage 1.....Nm	50	65 N	29	
- stage 2.....Nm	+ 90°	+ 90°	+ 50°	
- stage 3.....Nm	+ 90° ¹	+ 90°	+ 50° ¹	
- stage 4.....Nm	-	+ 90°	-	
- stage 5.....Nm	-	-	-	
- stage 6.....Nm	-	-	-	
Big-end bearings.....Nm	25 + 50° N	25 + 60° N	79 to 84 N	
Main bearings.....Nm	55, 110	25 + 100° N	43 to 48	
Crankshaft pulley bolt.....Nm	190	306 to 378 Left-hand	176	
Camshaft pulley bolt.....Nm	-	102 to 126	-	
Flywheel [driveplate] bolt.....Nm	140	168	108	
Front hubs.....Nm	WSM	235	356 to 400	
Rear hubs.....Nm	320	284	250 to 300	
Wheel nuts / bolts.....Nm	85 Alloy: 95	88 to 108	95 to 105	
Glow plugs.....Nm	17	28	23	
Clutch pressure plate bolts.....Nm	35	21	19 to 25	
Injection pump sprocket.....Nm	50	-	88	
Injectors.....Nm	78	-	30	
Injection pump mounting bolts.....Nm	29	-	-	
Injector pipe unions.....Nm	23	-	20	
Capacities				
Engine oil & filter.....litres	5.0	5.0	6.7	
Gearbox.....litres	1.4	2.0	1.55	
Automatic transmission.....litres	-	-	-	
Final drive.....litres	WT	WT	WT	
Cooling system.....litres	-	6.8	10.0 Refill: 8.0	
Fuel tank.....litres	-	63	70	

Notes

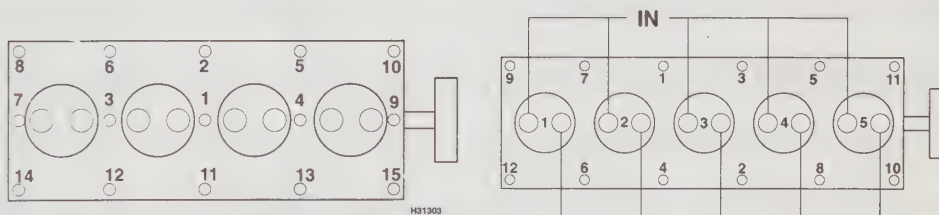
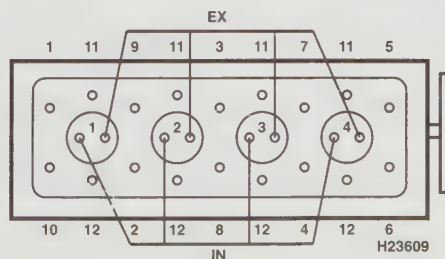
155 2.0 TD 1993 to 1997

¹Warm up, allow to cool, + 90° M8: 30, Warm up, allow to cool, + 30 Nm

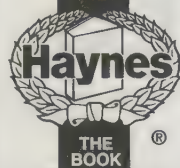
156 2.4 JTD 1998 to 2000

164 2.5 TD 1990 to 1994

¹run for 20 mins, wait 2.5 hrs, + 30° outside rows: + 88 Nm

1929 cm³2387 cm³2495 cm³

- Not applicable, or information not available



	A3 1.9 TDi 1996 to 1998	A3 1.9 TDi 110 1998 to 1999	80, 90 1.6 Turbo 1986 to 1991	80 1.9 1989 to 1991
Engine				
Engine type/code.....	AGR SOHC Turbo 66kW	AHF SOHC Turbo 81kW	SB SOHC Turbo 59kW	1Y SOHC 50kW
Capacity (cm ³) / cylinders.....	1896 / 4	1896 / 4	1588 / 4	1896 / 4
Compression ration / pressurebar	19.5 / 19 to 31	19.5 / 25 to 31	23.0 / ≥26.0	23.0 / ≥26.0
Torque outputNm	210	235	0	0
Oil pressureidle [running] bar	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	87	87	85	85
Radiator cap pressurebar	1.2 to 1.5	1.2	1.2 to 1.5	1.2 to 1.5
Fuel system				
Idle speedrpm	860 to 940	860 to 940	900 ± 30	900 ± 30
Maximum (no load) speedrpm	4800 to 5200	4800 to 5200	5100 ± 50	5050 ± 100
Smoke test/opacityM ⁻¹ %	2.0	2.0	2.0	2.0
Static timing method.....	Refer to wsm	Refer to wsm	Plunger travel	Plunger travel
Timing dimension.....mm	-	-	0.9 ± 0.02	1.0 ± 0.02
Crankshaft positionmm [°]	-	-	TDC	[0] TDC
Turbo type / ref / pressurebar	1.5 to 1.7 bar @ 3000 rpm	-	0.63 to 0.83 bar	-
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	-	VE	VE 4/9	-
Injector Make / type.....	Bosch	-	Bosch	Bosch
Injector part no.....	-	-	0 432 217 165	-
Injection type.....	EDC	Direct VE	VE	VE
Injection opening pressure, New [used]...bar	190 to 200 [170]	190 to 200 [170]	≥155 [≥140]	≥130 [≥120]
Glow plugs				
Maker	Bosch	Champion	Bosch/Champion	Champion
Type	0 250 202 022	CH171	0250 201 032 / CH69	CH69
Nominal rating.....V/A	11.5 /	-	11 / 13	11 / 13
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	2.0	2.0
Rear.....mm	7.0 with backing	7.0 with backing	2.5	2.5
Tyres - Saloon / Hatch.....Size	195/65x15	195/65x15	195/70x14	175/70x14
- Estate / Van.....Size	-	-	-	-
Pressure - front / rear - Saloon / Hatch...bar	1.8 / 1.8	Refer to vehicle	1.9 / 1.9	1.9 / 1.9
- Estate / Vanbar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 10°]	[0° ± 10°]	[10° ± 10°]	[10° ± 10°]
Camber	-0°30' ± 30' Sport: -33' ± 30'	-30' ± 30' Sport: -33' ± 30'	-45' ± 30'	-45' ± 30'
Castor	7°40' ± 30' Sport: 7°0' ± 30'	7°40' ± 30' Sport: 7°0' ± 30'	1°15' ± 30'	1°15' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°25' ± 15°]	[0°25' ± 15°]	[20° ± 20°]	[20° ± 20°]
Camber	-1°36' ± 20°	-1°36' ± 20°	-1° ± 20°	-1° ± 20°



AUDI

	A3 1.9 TDi 1996 to 1998	A3 1.9 TDi 110 1998 to 1999	80, 90 1.6 Turbo 1986 to 1991	80 1.9 1989 to 1991
Torque wrench settings				
Cylinder head - stage 1.....Nm	40 N	40 N	40	40
- stage 2.....Nm	+ 90°	+ 90°	60	60
- stage 3.....Nm	+ 90°	+ 90°	+ 180°	+ 180°
- stage 4.....Nm	-	-	Warm engine, + 90°	Warm engine
- stage 5.....Nm	-	-	After 1000km,	+ 90°
- stage 6.....Nm	-	-	+ 90°	-
Big-end bearings.....Nm	30 + 90° oiled N	30 + 90° oiled N	30 + 90° N	30 + 90° N
Main bearings.....Nm	40 + 90° N	40 + 90° N	65	65
Crankshaft pulley bolt.....Nm	90 + 90°	90 + 90°	Hexagon head: 180°	90 + 180°
Camshaft pulley bolt.....Nm	100	100	45	45
Flywheel [driveplate] bolt.....Nm	60 + 90° N	60 + 90° N	30 + 90°	30 + 90°
Front hubs.....Nm	1	1	265 LkC²	265 LkC¹
Rear hubs.....Nm	175	175	WSM	WSM
Wheel nuts / bolts.....Nm	120	120	110	110
Glow plugs.....Nm	15	15	30	30
Clutch pressure plate bolts.....Nm	25	13	25	25
Injection pump sprocket.....Nm	20 + 90° N	20 + 90° N	45	45
Injectors.....Nm	20	20	70	70
Injection pump mounting bolts.....Nm	25	25	25	25
Injector pipe unions.....Nm	15	25	25	25
Capacities				
Engine oil & filter.....litres	4.5	4.5	3.5 3.88 ▶: 4.0	4.5
Gearbox.....litres	1.9	1.9	2.4	2.4
Automatic transmission.....litres	5.3	5.3	-	-
Final drive.....litres	WT AT: 0.75	WT AT: 0.75	WT	WT
Cooling system.....litres	5.0	5.0	7.0	7.0
Fuel tank.....litres	-	55	68	68

Notes

A3 1.9 TDi 1996 to 1998

¹300, -360°, 50 + 30°

A3 1.9 TDi 110 1998 to 1999

¹300, -360°, 50 + 30°

80, 90 1.6 Turbo 1986 to 1991

¹Double hexagon head: 90 + 180°

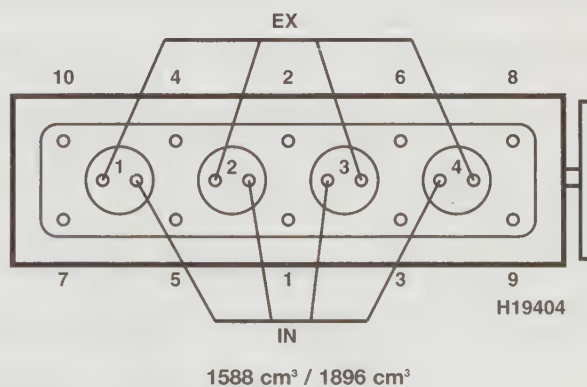
²PAS with M14 bolts: 120 + 90°.

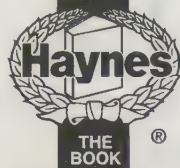
PAS with M16: 200 + 90°

80 1.9 1989 to 1991

¹PAS with M14 bolts: 120 + 90°.

PAS with M16: 200 + 90°





	80 1.9 Turbo CAT 1992 to 1994	80 1.9 TDi 1992 to 1996	A4 1.9 TDi CAT 1995 to 1996	A4 1.9 TDi CAT 1994 to 1999
Engine				
Engine type/code	AAZ SOHC Turbo 55kW	1Z SOHC 8V Turbo 66kW	1Z SOHC Turbo 66kW	AFN SOHC 8V Turbo 81kW
Capacity (cm ³) / cylinders	1896 / 4	1896 / 4	1896 / 4	1896 / 4
Compression ratio / pressurebar	22.5 / ≥26.0	19.5 / ≥26.0	19.5 / ≥19.0	19.5 / ≥19.0
Torque outputNm	140	202	202	225
Oil pressureidle [running] bar	[2.0 @ 2000]	[2.0 @ 2000]	1.0 to 2.5 [3.0 to 5.0]	1.0 to 2.5 [3.0 to 5.0]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	87	87	87	87
Radiator cap pressurebar	1.2 to 1.5	1.2 to 1.5	1.2 to 1.5	1.2 to 1.5
Fuel system				
Idle speedrpm	900 ± 30	900 ± 30	840 ± 60	780 to 900
Maximum (no load) speedrpm	5200 ± 100	5200 ± 100	5200 ± 100	5200 ± 100
Smoke test/opacityM ⁻¹ %	2.0	2.0	2.0	2.0
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	0.9 ± 0.02	0.9 ± 0.02	0.7 ± 0.02	0.7 ± 0.02
Crankshaft positionmm [°]	[0] TDC	[0] TDC	[0] TDC	[0] TDC
Turbo type / ref / pressurebar	1.6 to 1.8 bar	1.5 to 1.7 bar @ 3000 rpm	1.5 to 1.7 bar @ 3000 rpm	1.8 to 2.05 bar @ 3000
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VE 4/9	VE4/10	VE R510	VE R638
Injector Make / type	Bosch	Bosch	Bosch	Bosch
Injector part no.....	-	0 432 193 850	0 432 193 799	-
Injection type.....	VE	VE	Direct VE	Direct VE
Injection opening pressure, New [used]...bar	≥155 [≥140]	≥155 [≥140]	190 to 200 [170]	190 to 200 [170]
Glow plugs				
Maker	Bosch	Bosch	Bosch	Bosch
Type	0 250 201 032	0 250 202 009	0 250 202 009	0 250 202 022
Nominal rating.....V/A	11 / 12	11 / 12	11 / 12	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	7.0 with backing
Rear.....mm	2.5'	2.5'	7.0 with backing	7.0 with backing
Tyres - Saloon / Hatch.....Size	195/65x15: 205/60x15	195/65x15: 205/60x15	195/65x15: 205/60x16:205/55x16	195/65x15: 205/60x16:205/55x16
- Estate / Van.....Size	-	-	-	-
Pressure - front / rear - Saloon / Hatch...bar	1.8 / 1.8	1.8 / 1.8	2.0 / 2.0 205/55: 2.2 / 2.2	2.0 / 2.0 205/55: 2.2 / 2.2
- Estate / Vanbar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°10' ± 10']	[0°10' ± 10']	[0°10' ± 5']	[0°10' ± 5']
Camber	-0°45' ± 30'	-0°45' ± 30'	-0°20' ± 20'	-0°20' ± 20'
Castor	2°10' ± 30'	2°10' ± 30'	-	-
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°15' ± 10']	[0°15' ± 10'] PW	[0°10' ± 5']	[0°10' ± 5']
Camber	-1°30' ± 20'	-1°30' ± 20'	-1°30' ± 20'	-1°30' ± 20'



AUDI

	80 1.9 Turbo CAT 1992 to 1994	80 1.9 TDi 1992 to 1996	A4 1.9 TDi CAT 1995 to 1996	A4 1.9 TDi CAT 1994 to 1999
Torque wrench settings				
Cylinder head - stage 1.....Nm	40 N	40 N	40 N	40 N
- stage 2.....Nm	60	60	60	60
- stage 3.....Nm	+ 180°	+ 180°	+ 90°	+ 90°
- stage 4.....Nm	Warm engine	Warm engine	+ 90°	+ 90°
- stage 5.....Nm	+ 90°	+ 90°	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	30 + 90° N	30 + 90° N	30 + 90° N	30 + 90° N
Main bearings.....Nm	65	65	65 + 90° N	65 + 90° N
Crankshaft pulley bolt.....Nm	90 + 90°	90 + 90°	90 + 90°	90 + 90°
Camshaft pulley bolt.....Nm	45	45	45	45
Flywheel [driveplate] bolt.....Nm	30 + 90°	30 + 90°	60 + 90° N	60 + 90° N
Front hubs.....Nm	M14: 120 + 90° ²	M14: 120 + 90° ²	115 + 90° N M16: 190 + 90° N	120 + 90° N M16: 200 + 90° N
Rear hubs.....Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	110	110	120	120
Glow plugs.....Nm	30	30	15	15
Clutch pressure plate bolts.....Nm	25	25	25	25
Injection pump sprocket.....Nm	45	45	45	45
Injectors.....Nm	70	70	20	20
Injection pump mounting bolts.....Nm	25	25	25	25
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	4.5	4.5	3.5	3.5
Gearbox.....litres	2.35	2.35	2.25	2.25
Automatic transmission.....litres	-	3.5	-	-
Final drive.....litres	WT	WT AT: 0.75	WT	WT
Cooling system.....litres	6.5	6.5	7.5	7.5
Fuel tank.....litres	66	66	-	62

Notes

80 1.9 Turbo CAT 1992 to 1994

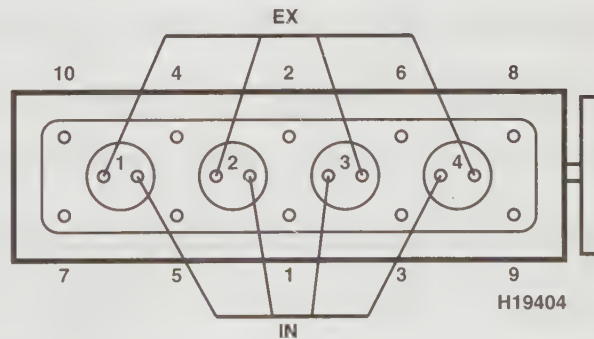
¹Discs: 7.0 with backing

²M16: 200 + 90°

80 1.9 TDi 1992 to 1996

¹Discs: 7.0 with backing

²M16: 200 + 90°



1588 cm³ / 1896 cm³

- Not applicable, or information not available



AUDI

	A4 2.5 TDi 1998 to 2000	A4 2.5 TDi 1998 to 2000	100 & A6 1.9 TDi 1995 to 1997	100 & Avant 2.0 D 1983 to 1991
Engine				
Engine type/code	AFB DOHC 24V V6 110kW	AKN DOHC 24V V6 110kW	1Z / AHU SOHC Turbo 66kW	CN SOHC 51kW
Capacity (cm ³) / cylinders	2497 / 6	2497 / 6	1896 / 4	1986 / 5
Compression ratio / pressure	19.5 / ≥24.0	19.5 / ≥24.0	19.5 / ≥19	23.0 / ≥26.0
Torque output	310	310	202	123
Oil pressureidle [running] bar	0.8 [2.0 @ 2000]	0.8 [2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0.15 to 0.25
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0.35 to 0.45
Injection order	1-4-3-6-2-5	1-4-3-6-2-5	1-3-4-2	1-2-4-5-3
No. 1 cylinder position	-	-	TBE	TBE
Cooling system				
Thermostat opening temperature°C	87	87	87	87
Radiator cap pressurebar	1.4 to 1.6	1.4 to 1.6	1.2 to 1.5	1.2 to 1.5
Fuel system				
Idle speedrpm	680 to 860	680 to 860	800 to 840 N/A	750 ± 50
Maximum (no load) speedrpm	4500 to 5500	4500 to 5500	5000 to 5200	5400 ± 50
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.0	2.0
Static timing method.....	Refer to wsm	Refer to wsm	Plunger travel	Plunger travel
Timing dimension.....mm	-	-	0.7 ± 0.02	0.85 ± 0.02
Crankshaft positionmm [°]	-	-	[0] TDC	[0] TDC
Turbo type / ref / pressurebar	-	-	1.8 to 2.05 bar @ 3000 rpm	-
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VP44	-	VE R440-1	VE L 35/137
Injector Make / type	-	-	Bosch	Bosch
Injector part no.....	-	-	0 432 193 838	0 432 217 059
Injection type.....	Direct VP	Direct	Direct VE EDC	Indirect VE
Injection opening pressure, New [used]...bar	180 to 190 [160]	180 to 190 [160]	190 to 200 [170]	≥130 [≥120]
Glow plugs				
Maker	Beru/Champion	Champion	Bosch/Champion	Beru/Champion
Type	GN855 / CH171	CH171	0 250 202 009 / CH171	N19 1001 / CH69
Nominal rating.....V/A	11.5 /	11 /	11 / 12	11 / 13
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	2.0	7.0 with backing
Rear.....mm	7.0 with backing	7.0 with backing	2.5 Disc: 2.0	2.5
Tyres - Saloon / Hatch.....Size	-	-	195/65x15:205/60x15:215/60x15	185/70x14
- Estate / Van.....Size	-	-	-	185/70x14
Pressure - front / rear - Saloon / Hatch...bar	-	-	2.3 / 2.3'	1.7 / 1.7
- Estate / Vanbar	-	-	-	1.7 / 1.7
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°20' ± 5']	[0°20' ± 15']	[15' + 5' - 10']	[0 + 5' - 10']
Camber	-0°25' ± 25''	-0°25' ± 25''	-40' + 35' - 25'	-30' ± 30'
Castor	-	-	1°10' ± 40'	-15' ± 40'' PAS: 50' ± 40'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°20' + 15' - 10'] ²	[0°20' + 15' - 10'] ²	[10' ± 5'] PW	[15' ± 10'] ²
Camber	-1°30' ± 20'' ³	-1°30' ± 20'' ³	-50' ± 30'	-40' ± 30'' ³



AUDI

	A4 2.5 TDi 1998 to 2000	A4 2.5 TDi 1998 to 2000	100 & A6 1.9 TDi 1995 to 1997	100 & Avant 2.0 D 1983 to 1991
Torque wrench settings				
Cylinder head - stage 1	Nm 35 N	35 N	40 N	40 N
- stage 2	Nm 60	60	60	60
- stage 3	Nm + 90°	+ 90°	+ 90°	+ 180°
- stage 4	Nm + 90°	+ 90°	+ 90°	Warm up, + 90°
- stage 5	Nm -	-	-	After 1000km,
- stage 6	Nm -	-	-	+ 90°
Big-end bearings	Nm 30 + 90° N	30 + 90° N	30 + 90° N	30 + 180° N
Main bearings	Nm WSM	WSM	65 + 90° N	65
Crankshaft pulley bolt	Nm 200 + 180° N	200 + 180° N	90 + 90° N	350
Camshaft pulley bolt	Nm 75	75	45	45 Pump end: 100
Flywheel [driveplate] bolt	Nm 60 + 180° N [60 + 90° N]	60 + 180° N [60 + 90° N]	60 + 90° N [60 + 90° N]	30 + 90°
Front hubs	Nm 115 + 180° N M16: 190 + 180° N	115 + 180° N M16: 190 + 180° N	200 + 90°	280
Rear hubs	Nm 4x4: 115 + 90° N	4x4: 115 + 90° N	WSM	WSM
Wheel nuts / bolts	Nm 120	-	110	110
Glow plugs	Nm 15	15	15	30
Clutch pressure plate bolts	Nm 25	25	25	25
Injection pump sprocket	Nm -	-	45	45
Injectors	Nm 10	-	20	70
Injection pump mounting bolts	Nm 20	-	25	25
Injector pipe unions	Nm 30	30	25	25
Capacities				
Engine oil & filter	litres 5.4	5.4	3.5	5.0
Gearbox	litres 2.4	2.4	2.4	2.6
Automatic transmission	litres -	-	3.0	3.0
Final drive	litres WT	WT	AT: 1.0	AT: 1.0
Cooling system	litres 10.0	10.0	6.5	8.0
Fuel tank	litres 62	62	80	80

Notes

A4 2.5 TDi 1998 to 2000

¹ Sports: -0°40' ± 25°

² Sports: [0°28' +15° -10°] 4x4: [0°15' ± 5°]

³ 4x4: -0°40' ± 30°

A4 2.5 TDi 1998 to 2000

¹ Sports: -0°40' ± 25°

² Sports: [0°28' +15° -10°] 4x4: [0°15' ± 5°]

³ 4x4: -0°40' ± 30°

100 & A6 1.9 TDi 1995 to 1997

² 15/60x15: 2.1 / 2.1

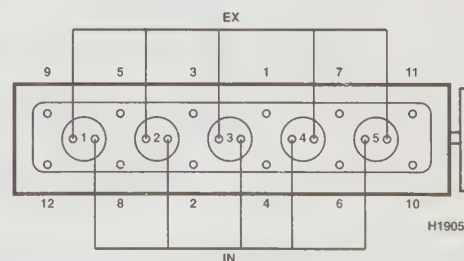
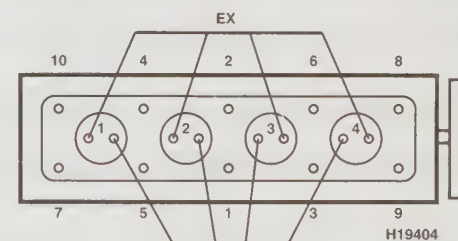
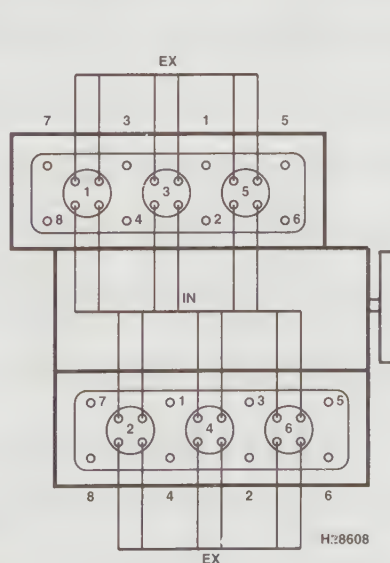
100 & Avant 2.0 D 1983 to 1991

¹ From chassis no. 44GA 024 419: 50° ± 40°

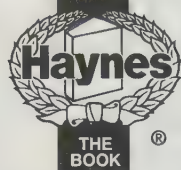
² From chassis no. EA 085 288 (Discs: EA 082

449): [10° ± 50°]

³ From chassis no. 44 JN 201 031: -50° ± 30°



- Not applicable, or information not available



AUDI

	100 & Avant 2.0 TD 1988 to 1991	100 & Avant 2.4 D 1989 to 1991	100 & Avant 2.5 TDi 1990 to 1991	100 & A6 2.5 TDi 1991 to 1997
Engine				
Engine type/code	NC SOHC Turbo 74kW	3D SOHC 60kW	1T SOHC Turbo 88kW	ABP SOHC Turbo 85kW
Capacity (cm ³) / cylinders	1986 / 5	2370 / 5	2461 / 5	2461 / 5
Compression ratio / pressure	23.0 / ≥26.0	22.5 / ≥26.0	20.5 / ≥24.0	20.5 / ≥24.0
Torque output	192 Nm	164	0	0
Oil pressureidle [running] bar	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-2-4-5-3	1-2-4-5-3	1-2-4-5-3	1-2-4-5-3
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	87	87	87	87
Radiator cap pressurebar	1.2 to 1.5	1.2 to 1.5	1.2 to 1.5	1.2 to 1.5
Fuel system				
Idle speedrpm	830 ± 30	830 ± 30	800 to 840	800 to 840 N/A
Maximum (no load) speedrpm	5100 ± 50	5000 ± 50	5200 ± 50	4500 to 5500
Smoke test/opacityM ⁻¹ %	2.0	2.0	2.5	2.5
Static timing method	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	0.9 ± 0.02	1.0 ± 0.02	0.35 ± 0.02	0.35 ± 0.02
Crankshaft positionmm [°]	[0] TDC	[0] TDC	[0] TDC	[0] TDC
Turbo type / ref / pressurebar	1.6 to 1.7 bar	-	0.8 to 0.9 bar	1.8 to 1.9 bar
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VE 5.10	-	VE5 11E	VE 5/11
Injector Make / type	Bosch	Bosch	Bosch	Bosch
Injector part no.....	0 432 217 165	0 432 217 206	0 432 193 838	0 432 193 877
Injection type.....	Indirect VE	Indirect VE	Direct EDC	Direct VE EDC
Injection opening pressure, New [used]...bar	≥155 [≥140]	≥130 [≥120]	≥180 [≥160]	≥180 [≥160]
Glow plugs				
Maker	Champion	Champion	Bosch/Champion	Champion
Type	CH69	CH69	0 250 202 009 / CH69	HDS342
Nominal rating.....V/A	10 / 12	11 / 13	11 / 13	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	2.0
Rear.....mm	2.5	2.5	2.5	2.5 Disc: 2.0
Tyres - Saloon / Hatch.....Size	185/70x14	185/70x14	185/70x14	195/65x15:205/60x15:215/60x15
- Estate / Van.....Size	185/70x14	185/70x14	185/70x14	-
Pressure - front / rear - Saloon / Hatch...bar	1.7 / 1.7	1.7 / 1.7	1.7 / 1.7	2.3 / 2.3'
- Estate / Van.....bar	1.7 / 1.7	1.7 / 1.7	1.7 / 1.7	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0 +5' -10']	[0° +5' -10']	[0° +5' -10']	[15' +5' -10']
Camber	-30' ± 30'	-30' ± 30'	-30' ± 30'	-40' +35' -25'
Castor	-15' ± 40' PAS: 50' ± 40'	50' ± 40'	50' ± 40'	1°10' ± 40'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[15' ± 10'] ²	[10' ± 5']	[10' ± 5']	[10' ± 5'] PW
Camber	-40' ± 30' ³	-50' ± 30'	-50' ± 30'	-50' ± 30'



AUDI

	100 & Avant 2.0 TD 1988 to 1991	100 & Avant 2.4 D 1989 to 1991	100 & Avant 2.5 TDi 1990 to 1991	100 & A6 2.5 TDi 1991 to 1997
Torque wrench settings				
Cylinder head - stage 1.....Nm	40 N	40 N	40 N	40 N
- stage 2.....Nm	60	60	60	60
- stage 3.....Nm	+ 180°	+ 180°	+ 180°	+ 180°
- stage 4.....Nm	Warm up, + 90°	Warm up, + 90°	Warm up, + 90°	Warm up, + 90°
- stage 5.....Nm	After 1000km,	After 1000km,	After 1000km,	After 1000km,
- stage 6.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
Big-end bearings.....Nm	30 + 180° N	30 + 90° N	30 + 90° N	30 + 90° N
Main bearings.....Nm	65	65	65	30 + 90°
Crankshaft pulley bolt.....Nm	350	350	100 + 180°	160 + 180°
Camshaft pulley bolt.....Nm	45 Pump end: 100	45 Pump end: 100	120 Pump end: 160	30 + 90°
Flywheel [driveplate] bolt.....Nm	30 + 90°	30 + 90°	30 + 90°	30 + 90°
Front hubs.....Nm	280	280	280	200 + 90°
Rear hubs.....Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	110	110	110	110
Glow plugs.....Nm	30	30	15	15
Clutch pressure plate bolts.....Nm	25	25	25	25
Injection pump sprocket.....Nm	45	45	45	160
Injectors.....Nm	70	70	20	20
Injection pump mounting bolts.....Nm	25	25	20	25
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	5.0	5.0	4.5	5.0
Gearbox.....litres	2.6	2.6	2.6	2.4
Automatic transmission.....litres	3.0	3.0	3.0	3.0
Final drive.....litres	AT: 1.0	AT: 1.0	AT: 1.0	AT: 1.0
Cooling system.....litres	9.4	8.0	8.5	6.5
Fuel tank.....litres	80	80	80	80

Notes

100 & Avant 2.0 TD 1988 to 1991

¹From chassis no. 44 GA 024 419: 50' ± 40'

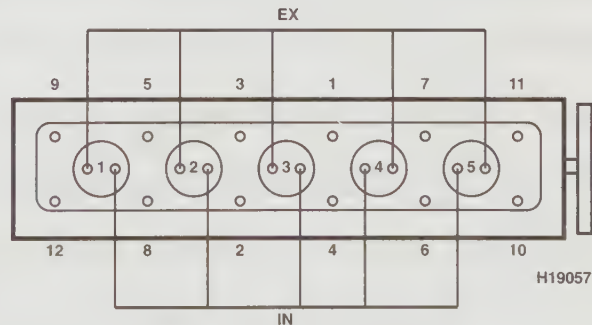
²From chassis no. EA 085 288(Discs: EA 082 449):

[10' ± 5'

³From chassis no. 44 JN 201 031: -50' ± 30'

100 & A6 2.5 TDi 1991 to 1997

²15/60x15: 2.1 / 2.1



1986 cm³ / 2370 cm³ / 2461 cm³



	100 & A6 2.5 TDi 1991 to 1997	A6 1.9 TDi 1994 to 1997	A6 1.9 TDi 1997 to 2000	A6 2.5 TDi 1994 to 1997
Engine				
Engine type/code.....	AAT SOHC Turbo 85kW	1Z SOHC Turbo 66kW	AFN SOHC Turbo 81kW	AEL SOHC Turbo 103kW
Capacity (cm ³) / cylinders.....	2461 / 5	1896 / 4	1896 / 4	2461 / 5
Compression ratio / pressure.....bar	20.5 / ≥24.0	19.5 /	19.5 /	20.5 / ≥24.0
Torque output.....Nm	0	202	230	290
Oil pressure.....idle [running] bar	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order.....	1-2-4-5-3	1-3-4-2	1-3-4-2	1-2-4-5-3
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature.....°C	87	87	87	87
Radiator cap pressure.....bar	1.2 to 1.5	1.2 to 1.5	1.2 to 1.5	1.2 to 1.5
Fuel system				
Idle speed.....rpm	750 to 810	800 to 900	820 to 900	780 ± 30
Maximum (no load) speed.....rpm	4500 to 5500	5000 to 5200	4800 to 5200	4500 to 4800
Smoke test/opacity.....M ⁻¹ %	2.5	2.5	2.0	2.0
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	0.35 ± 0.02	0.7 ± 0.02	0.7 ± 0.02	0.35 ± 0.02
Crankshaft position.....mm [°]	[0] TDC	TDC [0]	TDC [0]	[0] TDC
Turbo type / ref / pressure.....bar	1.8 to 1.9 bar	-	1.5 to 1.7 bar @ 3000 rpm	-
Injection pump make.....	Bosch	-	Bosch	Bosch
Injection pump part no.....	VEL 400/460-1	-	VP 37	-
Injector Make / type.....	Bosch	-	-	Bosch
Injector part no.....	0 432 193 858/6	-	-	0 432 193 786
Injection type.....	Direct VE EDC	Direct	Direct VP	Direct VE EDC
Injection opening pressure, New [used]...bar	≥180 [≥160]	190 to 200 [170]	190 to 200 [170]	≥180 [≥160]
Glow plugs				
Maker.....	Champion	Champion	Bosch/Champion	Bosch
Type.....	HDS342	HDS342	0 250 202 022 / HDS342	0 250 202 009
Nominal rating.....V/A	11 / 12	-	11 / 12	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	2.5 Disc: 2.0	2.5 Disc: 2.0	2.5 Disc: 2.0	2.5 Disc: 2.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/65x15: 205/60x15'	195/65x15: 205/60x15	195/65x15: 205/60x15	195/65x15: 205/60x15'
Pressure - front / rear - Saloon / Hatch...bar	1.9 / 1.9 ²	1.9 / 1.9	1.9 / 1.9	1.9 / 1.9 ²
- Estate / Van.....bar	-	1.9 / 1.9	1.9 / 1.9	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[15' +5' -10']	[15' ± 5']	[15' ± 5']	[15' +5' -10']
Camber.....	-40' +35' -25'	-40' +35' -25' Sports: -50'	-40' +35' -25' Sports: -50'	-40' +35' -25'
Castor.....	1°10' ± 40'	1°10' ± 40'	1°10' ± 40'	1°10' ± 40'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[10' ± 5'] PW	[20' ± 10']	[20' ± 10']	[10' ± 5'] PW
Camber.....	-50' ± 30'	-50' ± 30'	-50' ± 30'	-50' ± 30'



AUDI

	100 & A6 2.5 TDi 1991 to 1997	A6 1.9 TDi 1994 to 1997	A6 1.9 TDi 1997 to 2000	A6 2.5 TDi 1994 to 1997
Torque wrench settings				
Cylinder head - stage 1	40 N	40 N	40 N	40 N
- stage 2	60	60	60	60
- stage 3	+ 180°	+ 90°	+ 90° N	+ 180°
- stage 4	Warm up, + 90°	+ 90°	+ 90° N	Warm up, + 90°
- stage 5	After 1000km,	-	-	After 1000km,
- stage 6	+ 90°	-	-	+ 90°
Big-end bearings	30 + 90° N	30 + 90° N	30 + 90° N	30 + 90° N
Main bearings	30 + 90°	65 + 90° N	65 + 90° N	30 + 90°
Crankshaft pulley bolt	160 + 180°	90 + 90° N	90 + 90° N	160 + 180°
Camshaft pulley bolt	30 + 90°	20	45	30 + 90°
Flywheel [driveplate] bolt	30 + 90°	60 + 90° N	60 + 90° N	30 + 90°
Front hubs	200 + 90°	200 + 90°	200 + 90°	200 + 90°
Rear hubs	WSM	WSM	WSM	WSM
Wheel nuts / bolts	110	110	110	110
Glow plugs	15	15	15	15
Clutch pressure plate bolts	25	25	25	25
Injection pump sprocket	50 Gear: 160	45	45	50 Gear: 160
Injectors	20	20	20	20
Injection pump mounting bolts	25	25	25	25
Injector pipe unions	25	25	25	25
Capacities				
Engine oil & filter	litres 5.0	3.5	3.0	5.0
Gearbox	litres 2.4	2.4	2.4	2.4
Automatic transmission	litres 3.0	3.0	3.0	3.0
Final drive	litres AT: 1.0	AT: 1.0	AT: 1.0	AT: 1.0
Cooling system	litres 6.5	7.5	7.0	6.5
Fuel tank	litres 80	80	80	80

Notes

100 & A6 2.5 TDi 1991 to 1997

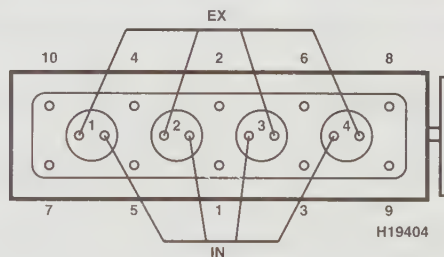
*Also 215/60x15

*215/60x15: 1.8 / 1.8

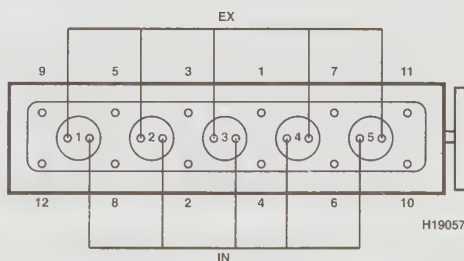
A6 2.5 TDi 1994 to 1997

*Also 215/60x15

*215/60x15: 1.8 / 1.8



1896 cm³



2461 cm³

– Not applicable, or information not available



AUDI

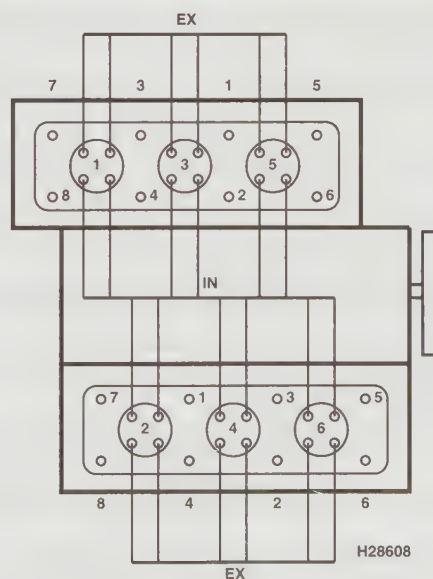
	A6 2.5 TDi 1997 to 2000	A6 2.5 TDi 1998 to 2000	A8 2.5 TDi 1996 to 1998	A8 2.5 TDi 1999 to 2000
Engine				
Engine type/code.....	AFB DOHC 24V Turbo 110kW	AKN DOHC 24V Turbo 110kW	AFB DOHC 24V Turbo 110kW	AKN DOHC 24V Turbo 110kW
Capacity (cm ³) / cylinders.....	2496 / 6	2496 / 6	2496 / 6	2496 / 6
Compression ratio / pressurebar	19.5 / _	19.5 / ≥24.0	19.5 /	19.5 / ≥24.0
Torque outputNm	310	310	310	310
Oil pressureidle [running] bar	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	-	-	1-4-3-6-2-5	1-4-3-6-2-5
No. 1 cylinder position	TBE	TBE	PER	PER
Cooling system				
Thermostat opening temperature°C	87	87	87 to 102	87
Radiator cap pressurebar	1.2 to 1.5	1.2 to 1.5	1.2 to 1.5	1.2 to 1.5
Fuel system				
Idle speedrpm	780 ± 40	680 to 860	780 ± 40	680 to 860
Maximum (no load) speedrpm	4500 to 5500	4500 to 5500	4500 to 5500	4500 to 5500
Smoke test/opacityM ⁻¹ %	2.0	2.0	2.0	2.0
Static timing method.....	Plunger travel	Plunger travel	Refer to wsm	Refer to wsm
Timing dimension.....mm	0.7 ± 0.02	0.7 ± 0.02	-	-
Crankshaft positionmm [°]	TDC [0]	TDC [0]	-	-
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make	Bosch	-	Bosch	Bosch
Injection pump part no.....	VP 44	-	VP44	-
Injector Make / type	-	-	-	-
Injector part no.....	-	-	-	-
Injection type.....	Direct VP	Direct	Direct VP	Direct
Injection opening pressure, New [used]...bar	190 to 200 [170]	190 to 200 [170]	190 to 200 [170]	190 to 200 [160]
Glow plugs				
Maker	Beru	-	Beru	Champion
Type	GN855	-	GN855	CH171
Nominal ratingV/A	11.5 /	-	11.5 /	-
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	3.0	3.0
Rear.....mm	2.5 Disc: 2.0	2.5 Disc: 2.0	7.0 with backing	7.0 with backing
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/65x15: 205/60x15	195/65x15: 205/60x15	225/60x16: 225/55x17	225/60x16: 225/55x17
Pressure - front / rear - Saloon / Hatch ...bar	1.9 / 1.9	1.9 / 1.9	2.0 / 2.0	2.0 / 2.0
- Estate / Vanbar	1.9 / 1.9	1.9 / 1.9	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[15' ± 5']	[15' ± 5']	[15' ± 5'] PW	[15' ± 5'] PW
Camber	-40' +35' -25' Sports: -50'	-40' +35' -25' Sports: -50'	-30' ± 30' PW	-30' ± 30' PW
Castor	1°10' ± 40'	1°10' ± 40'	-	-
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[20' ± 10']	[20' ± 10']	[6' ± 5'] PW	[6' ± 5'] PW
Camber	-50' ± 30'	-50' ± 30'	-40' ± 30' PW	-40' ± 30' PW



AUDI

	A6 2.5 TDi 1997 to 2000	A6 2.5 TDi 1998 to 2000	A8 2.5 TDi 1996 to 1998	A8 2.5 TDi 1999 to 2000
Torque wrench settings				
Cylinder head - stage 1Nm	35 N	35 N	35 N	35 N
- stage 2Nm	60	60	60	60
- stage 3Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5Nm	-	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	30 + 90° N	30 + 90° N	30 + 90° N	30 + 90° N
Main bearings.....Nm	60 + 90° N	WSM	60 + 90° N	WSM
Crankshaft pulley boltNm	200 + 180° N	200 + 180° N	200 + 180° N	200 + 180° N
Camshaft pulley boltNm	80	75	80	75
Flywheel [driveplate] bolt.....Nm	60 + 180° N [60 + 90° N]	60 + 180° N [60 + 90° N]	60 + 90° N Dual mass: 40 + 180°	60 + 180° N [60 + 90° N]
Front hubsNm	200 + 90°	200 + 90°	190 + 180° N	190 + 180° N
Rear hubsNm	WSM	WSM	190 + 180° N	190 + 180° N
Wheel nuts / boltsNm	110	110	120	120
Glow plugsNm	15	15	15	15
Clutch pressure plate boltsNm	25	25	25	25
Injection pump sprocket.....Nm	45	45	-	45
Injectors.....Nm	20	20	10	20
Injection pump mounting boltsNm	25	25	20	25
Injector pipe unions.....Nm	25	25	30	25
Capacities				
Engine oil & filter.....litres	5.4	5.4	5.4	5.4
Gearbox.....litres	2.4	2.4	2.4	2.4
Automatic transmissionlitres	3.0	3.0	2.4	2.4
Final drive.....litres	AT: 1.0	AT: 1.0	WT	WT
Cooling system.....litres	10.0	10.0	10.0	10.0
Fuel tank.....litres	80	80	70	-

Notes



2496 cm³

- Not applicable, or information not available



BMW

	318tds Compact 1998 to 2000	318tds Touring 1998 to 2000	325td 1995 to 1998	325tds 1995 to 1998
Engine				
Engine type/code.....	M41 SOHC Turbo 66kW	M41 SOHC Turbo 66kW	M51/D25 SOHC Turbo 85kW	M51/D25 SOHC Turbo 105kW ¹
Capacity (cm ³) / cylinders.....	1665 / 4	1665 / 4	2498 / 6	2498 / 6
Compression ratio / pressure.....bar	22.0 /	22.0 /	22 / ≥20.0	22 / ≥20.0
Torque output.....Nm	190	190	222	260
Oil pressure.....idle [running] bar	≥0.5	≥0.5	2.0	2.0
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-5-3-6-2-4	1-5-3-6-2-4
No. 1 cylinder position.....	TCE	TCE	TCE	TCE
Cooling system				
Thermostat opening temperature.....°C	80	80	80	80
Radiator cap pressure.....bar	1.4	1.4	1.2 to 1.6	1.2 to 1.6
Fuel system				
Idle speed.....rpm	820 ± 50	820 ± 50	750 ± 50	750 ± 50
Maximum (no load) speed.....rpm	5200 to 5300	5250	5300 ± 100	5300 ± 100
Smoke test/opacity.....M ⁻¹ %	2.5	1.9	2.5	2.1
Static timing method.....	Dial gauge	Dial gauge	Plunger travel	Plunger travel
Timing dimension.....mm	0.6 ± 0.03	0.6	0.95 ± 0.02	0.95 ± 0.02
Crankshaft position.....mm [°]	TDC	TDC	TDC	TDC
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VP36	VP36	VE	VP36
Injector Make / type.....	-	Bosch	Bosch	Bosch
Injector part no.....	DNOSD 318	DNOSD 318	0 432 217 223	0 432 217 223
Injection type.....	Indirect VP	Indirect VP	Indirect VE	Indirect VP
Injection opening pressure, New [used]...bar	140	140	150 to 158 [140]	150 to 158 [140]
Glow plugs				
Maker.....	Bosch	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type.....	0 250 201 033	0 250 201 033 / CH159	0 250 201 033 / CH159	0 250 201 033 / CH159
Nominal rating.....V/A	12 / 14	12 / 14	11.5 / 13	11.5 / 13
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	1.5	1.5	2.0	2.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185/65x15: 205/55x16	-	185/65x15	205/60x15
Pressure - front / rear - Saloon / Hatch...bar	1.8 / 2.2 : 1.8 / 2.0	-	1.8 / 2.1	2.0 / 2.3
- Estate / Van.....bar	-	2.0 / 2.3: 1.8 / 2.0	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°18' ± 5']	[0°18' ± 5']	[18' ± 8']	[18' ± 8']
Camber.....	-0°20' ± 30' Sport: -51' ± 30'	-0°20' ± 30' Sport: -51' ± 30'	-0°30 ± 30'	-0°30 ± 30'
Castor.....	3°52' ± 30' Sport: 3°57' ± 30'	3°52' ± 30' Sport: 3°57' ± 30'	3°52 ± 30'	3°52' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[30' ± 13'] Sport: [36' ± 13']	[30' ± 13'] Sport: [36' ± 13']	[24' ± 6']	[24' ± 6']
Camber.....	-2° ± 30' Sport: -2°30' ± 30'	-2° ± 30' Sport: -2°30' ± 30'	-1°40' ± 15'	-1°40' ± 15'

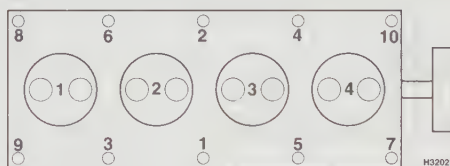


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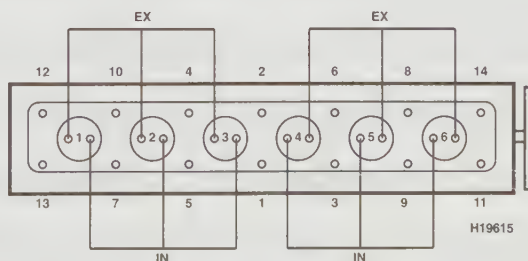
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Torque wrench settings				
Cylinder head - stage 1.....Nm	80, slacken 180° N	80, slacken 180° N	80, slacken	80, slacken
- stage 2.....Nm	50 + 90°	50 + 90°	50	50
- stage 3.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4.....Nm	Warm up	Warm up	+ 90°	+ 90°
- stage 5.....Nm	+ 90°	+ 90°	warm up	warm up
- stage 6.....Nm	-	-	+ 90°	+ 90°
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	23 + 70° N	23 + 70° N
Main bearings.....Nm	20 + 50° N	20 + 50° N	23 + 50°	23 + 50°
Crankshaft pulley bolt.....Nm	330	330	100 + 150°	100 + 150°
Camshaft pulley bolt.....Nm	20 + 35°	20 + 35°	20 + 35°	20 + 35°
Flywheel [driveplate] bolt.....Nm	120 N	120 N	120	105 [120]
Front hubs.....Nm	290	290	290	290
Rear hubs.....Nm	200	200	248	248
Wheel nuts / bolts.....Nm	100 ± 10	100 ± 10	100	100
Glow plugs.....Nm	20	20	20	20
Clutch pressure plate bolts.....Nm	WSM	WSM	24	24
Injection pump sprocket.....Nm	50	50	48	48
Injectors.....Nm	65	65	65	65
Injection pump mounting bolts.....Nm	-	-	22	22
Injector pipe unions.....Nm	20	20	22	22
Capacities				
Engine oil & filter.....litres	5.5	5.5	6.5	6.5
Gearbox.....litres	1.0	1.0	1.3	1.3
Automatic transmission.....litres	-	-	3.0	3.0
Final drive.....litres	1.1	1.1	1.7	1.7
Cooling system.....litres	7.5	7.5	8.75	8.75
Fuel tank.....litres	52	62	65	65

Notes

325tds 1995 to 1998
*with intercooler



1665 cm³



2499 cm³

- Not applicable, or information not available



BMW

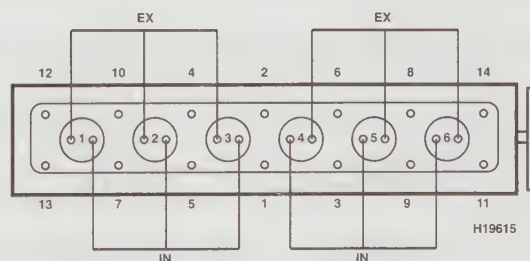
	325tds Touring 1998 to 2000	525td 1993 to 1996	525tds 1993 to 1997	525tds 1996 to 1997
Engine				
Engine type/code.....	M51/D25 SOHC 105kW	M51/D25 SOHC Turbo 85kW	M51/D25 SOHC Turbo 105kW	M51/D25 SOHC 105kW
Capacity (cm ³) / cylinders.....	2498 / 6	2498 / 6	2498 / 6	2498 / 6
Compression ration / pressurebar	22.0 /	22.0 /	22.0 /	22.0 /
Torque outputNm	260	222	260	260
Oil pressureidle [running] bar	≥0.5	≥0.5 / 4.0	≥0.5 / 4.0	≥0.5 / 4.0
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
No. 1 cylinder position	TCE	TCE	TCE	TCE
Cooling system				
Thermostat opening temperature°C	80	82	82	82
Radiator cap pressurebar	1.4	1.2 to 1.6	1.2 to 1.6	1.2 to 1.6
Fuel system				
Idle speedrpm	770 ± 50	750 ± 50	750 ± 50	750 ± 50
Maximum (no load) speedrpm	5300	5250 ± 50	5250 ± 50	5250
Smoke test/opacityM ⁻¹ %	2.5	2.4	2.1	2.5
Static timing method.....	Dial gauge	Rotor lift	Rotor lift	Rotor lift
Timing dimension.....mm	0.95	0.95 ± 0.02	0.95 ± 0.02	0.95 ± 0.02
Crankshaft positionmm [°]	0 TDC	TDC	TDC	TDC
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VP36	VP15	VP15	VP 36 VE6/10E 2400 R515
Injector Make / type.....	-	-	-	-
Injector part no.....	DNOSD 300	-	-	-
Injection type.....	Indirect VP36	Indirect VP	Indirect VP	DDE 2.1
Injection opening pressure, New [used]...bar	140	140 to 160	140 to 160	140 to 160
Glow plugs				
Maker	Champion	Bosch/Champion	Bosch/Champion	Bosch/Beru
Type	CH159	0 250 201 033 / CH159	0 250 201 033 / CH159	0250 201 033 / 719 MJ
Nominal rating.....V/A	11 /	11.5 / 13	11.5 / 13	12 / 14
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	3.0
Rear.....mm	1.5	2.0	2.0	3.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	205/60x15	205/65x15	205/65x15	205/65x15
Pressure - front / rear - Saloon / Hatch...bar	-	2.0 / 2.1	2.0 / 2.1	-
- Estate / Vanbar	2.0 / 2.3	2.3 / 2.6	2.3 / 2.6	Refer to vehicle
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°18' ± 5']	[18' ± 5']	[18' ± 5']	[18' ± 10']
Camber	-30' ± 30' Sport: -51' ± 30'	-0°13' ± 30'	-0°13' ± 30'	-0°30' ± 30'
Castor	3°52' ± 30' Sport: 3°57' ± 30'	8°08' ± 30'	8°08' ± 30'	3°52' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[30' ± 13'] Sport: [36' ± 13']	[25' ± 7']	[25' ± 7']	[24' ± 10']
Camber	-2° ± 30' Sport: -2°30' ± 30'	-2°20' ± 30'	-2°20' ± 30'	-1°40' ± 20'



BMW

	325tds Touring 1998 to 2000	525td 1993 to 1996	525tds 1993 to 1997	525tds 1996 to 1997
Torque wrench settings				
Cylinder head - stage 1.....Nm	80, slacken 180° N	80 N	80 N	80 N
- stage 2.....Nm	50 + 90°	Slacken 180°	Slacken 180°	Slacken 180°
- stage 3.....Nm	+ 90°	50	50	50
- stage 4.....Nm	Warm up	+ 90°	+ 90°	+ 90°
- stage 5.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 6.....Nm	-	Warm-up + 90°	Warm-up + 90°	Warm-up + 90°
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	20 + 50° N	20 + 50° N	20 + 50° N	20 + 50° N
Crankshaft pulley bolt.....Nm	330	100 + 150°	100 + 150°	100 + 150°
Camshaft pulley bolt.....Nm	-	20 + 35°	20 + 35°	20 + 35°
Flywheel [driveplate] bolt.....Nm	105 [120] N	105 N [120 N]	105 N [120 N]	105 N [120 N]
Front hubs.....Nm	290	290	290	290
Rear hubs.....Nm	250	250	250	250
Wheel nuts / bolts.....Nm	100 ± 10	100 ± 10	100 ± 10	100 ± 10
Glow plugs.....Nm	24	20	20	20
Clutch pressure plate bolts.....Nm	WSM	24	24	24
Injection pump sprocket.....Nm	-	50	50	45 to 50
Injectors.....Nm	65	65	65	65
Injection pump mounting bolts.....Nm	-	22	22	25
Injector pipe unions.....Nm	-	22	22	20 to 25
Capacities				
Engine oil & filter.....litres	7.0	6.75	6.75	6.75
Gearbox.....litres	1.25	1.2	1.2	1.2
Automatic transmission.....litres	3.0	3.3	3.3	-
Final drive.....litres	1.7	1.7	1.7	1.0
Cooling system.....litres	8.75	9.75	9.75	9.75
Fuel tank.....litres	65	80	80	70

Notes



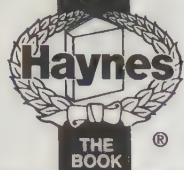
2498 cm³

- Not applicable, or information not available



BMW

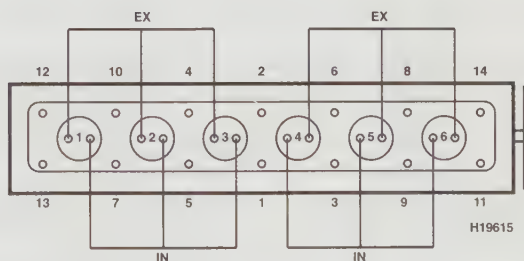
	525tds Touring 1997 to 1998	725tds 1996 to 1997		
Engine				
Engine type/code.....	M51/D25 SOHC Turbo 110kW	M51/D25 SOHC 105kW		
Capacity (cm ³) / cylinders.....	2498 / 6	2498 / 6		
Compression ratio / pressure.....bar	22.0 /	22.0 /		
Torque output.....Nm	260	260		
Oil pressure.....idle [running] bar	≥0.5	≥0.5 [4.0]		
Oil temperature.....°C	80	80		
Valve clearances - inlet (mm).....	0: Hyd.	0: Hyd.		
- exhaust (mm).....	0: Hyd.	0: Hyd.		
Injection order.....	1-5-3-6-2-4	1-5-3-6-2-4		
No. 1 cylinder position.....	TCE	TCE		
Cooling system				
Thermostat opening temperature.....°C	80	92		
Radiator cap pressure.....bar	1.4	-		
Fuel system				
Idle speed.....rpm	770 ± 50	750 ± 50		
Maximum (no load) speed.....rpm	5300	-		
Smoke test/opacity.....M ⁻¹ %	2.1	2.5		
Static timing method.....	Dial gauge	Refer to wsm		
Timing dimension.....mm	0.95	-		
Crankshaft position.....mm [°]	0 TDC	-		
Turbo type / ref / pressure.....bar	-	-		
Injection pump make.....	Bosch	Bosch		
Injection pump part no.....	VP36	VP36 VE 6/10E 2400 R515		
Injector Make / type.....	-	-		
Injector part no.....	DNOSD 300	-		
Injection type.....	Indirect VP36	DDE 2.1		
Injection opening pressure, New [used]...bar	140	140 to 160		
Glow plugs				
Maker.....	Bosch/Champion	Bosch		
Type.....	0 250 201 033 / CH159	0250 201 033		
Nominal rating.....V/A	12 / 14	12 / 14		
Brakes				
minimum friction material thickness				
Front.....mm	2.0	3.0		
Rear.....mm	1.5	3.0		
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	205/60x15	-		
Pressure - front / rear - Saloon / Hatch...bar	-	Refer to vehicle		
- Estate / Van.....bar	2.0 / 2.3	-		
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°5' ± 5']	[0°14' ± 10']		
Camber.....	-0°13' ± 30' Sport: -35'±30'	-0°13' ± 30'		
Castor.....	6°42' ± 30' Sport: 6°55'±30'	6°06' ± 30'		
King pin inclination.....	-	-		
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°16' ± 10']	[0°18' ± 10']		
Camber.....	-2°10' ± 20'	-1°30' ± 20'		



BMW

	525tds Touring 1997 to 1998	725tds 1996 to 1997		
Torque wrench settings				
Cylinder head - stage 1Nm	80, slacken 180° N	80 N		
- stage 2Nm	50 + 90°	Slacken 180°		
- stage 3Nm	+ 90°	50		
- stage 4Nm	Warm up	+ 90°		
- stage 5Nm	+ 90°	+ 90°		
- stage 6Nm	-	warm-up + 90°		
Big-end bearings.....Nm	20 + 70° N	20 + 70° N		
Main bearings.....Nm	20 + 50° N	20 + 50° N		
Crankshaft pulley boltNm	330	100 + 150°		
Camshaft pulley boltNm	20 + 35°	20 + 35°		
Flywheel [driveplate] bolt.....Nm	105 [120] N	105		
Front hubsNm	290	-		
Rear hubsNm	300	300		
Wheel nuts / boltsNm	100 ± 10	100 ± 10		
Glow plugsNm	20	20		
Clutch pressure plate boltsNm	WSM	24		
Injection pump sprocket.....Nm	45	-		
Injectors.....Nm	65	50		
Injection pump mounting boltsNm	25	-		
Injector pipe unions.....Nm	22	-		
Capacities				
Engine oil & filter.....litres	6.75	7.0		
Gearbox.....litres	1.25	1.3		
Automatic transmissionlitres	3.0	-		
Final drivelitres	1.0	1.2		
Cooling system.....litres	10.5	10.5		
Fuel tank.....litres	70	85		

Notes



2498 cm³

- Not applicable, or information not available



CARBODIES LTI

	FX4S 2.5 1985 to 1991	FX4S 2.7 1989 to 1991		
Engine				
Engine type/code.....	Land Rover OHV	Nissan TD27 OHV		
Capacity (cm ³) / cylinders.....	2495 / 4	2663 / 4		
Compression ration / pressurebar	21.0 / _	21.8 / ≥24.5		
Torque outputNm	0	0		
Oil pressureidle [running] bar	[2.4 to 4.5]	[2.9 to 3.9]		
Oil temperature°C	80	80		
Valve clearances - inlet (mm)	0.25	0.35 H		
- exhaust (mm)	0.25	0.35 H		
Injection order.....	1-3-4-2	1-3-4-2		
No. 1 cylinder position	F	F		
Cooling system				
Thermostat opening temperature°C	82	82		
Radiator cap pressurebar	0.62	0.78 to 0.98		
Fuel system				
Idle speedrpm	650 ± 20	700 ± 50		
Maximum (no load) speedrpm	4400 ± 80	5100 +50 -150		
Smoke test/opacityM ⁻¹ %	2.5	2.5		
Static timing method.....	-	Plunger travel		
Timing dimension.....mm	-	0.65 ± 0.02 [5]		
Crankshaft positionmm [°]	-	[0] TDC		
Turbo type / ref / pressurebar	-	-		
Injection pump make	CAV	Diesel Kiki		
Injection pump part no.	-	16700-43G13		
Injector Make / type.....	CAV	Diesel Kiki		
Injector part no.....	BDNO SPC 6209	16600-43G02		
Injection type.....	Indirect DPS	Indirect VE		
Injection opening pressure, New [used]...bar	≥135	103 to 113 [98 to 103]		
Glow plugs				
Maker	Champion	Champion		
Type	CH63	CH63		
Nominal rating.....V/A	12.0 / _	-		
Brakes				
minimum friction material thickness				
Front.....mm	-	-		
Rear.....mm	-	-		
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175x16: 185x16	175x16: 185x16		
Pressure - front / rear - Saloon / Hatch...bar	2.4 / 2.2'	2.4 / 2.2'		
- Estate / Vanbar	-	-		
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.6	1.6		
Camber	1°	1°		
Castor	3°	3°		
King pin inclination.....	6.5°	6.5°		
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-		
Camber	-	-		



CARBODIES LTI

Torque wrench settings

	FX4S 2.5 1985 to 1991	FX4S 2.7 1989 to 1991
Cylinder head - stage 1Nm	115 to 130	39 to 44
- stage 2Nm	-	54 to 59
- stage 3Nm	-	+ 90 ± 10°
- stage 4Nm	-	-
- stage 5Nm	-	-
- stage 6Nm	-	-
Big-end bearings.....Nm	34 to 46	78 to 83 N
Main bearings.....Nm	130 to 136	167 to 177
Crankshaft pulley boltNm	260 to 280	294 to 324
Camshaft pulley boltNm	40 to 50	44 to 49
Flywheel [driveplate] bolt.....Nm	130 to 143	147 to 167
Front hubsNm	-	-
Rear hubs.....Nm	-	-
Wheel nuts / boltsNm	88	88
Glow plugsNm	34	15 to 20
Clutch pressure plate boltsNm	25 to 34	25 to 34
Injection pump sprocket.....Nm	-	59 to 69
Injectors.....Nm	22 to 28	54 to 64
Injection pump mounting boltsNm	22 to 28	30 to 41
Injector pipe unions.....Nm	-	20 to 25

Capacities

Engine oil & filter.....litres	6.9	5.9
Gearbox.....litres	2.0	2.0
Automatic transmissionlitres	Type 35: 6.4 ²	Type 35: 6.4 ²
Final drive.....litres	2.0	2.0
Cooling system.....litres	10.3	10.3
Fuel tank.....litres	58.2	58.2

Notes

FX4S 2.5 1985 to 1991

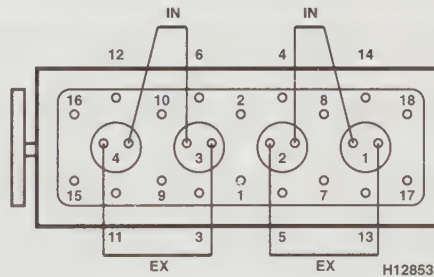
¹185x16: 2.5 / 2.5

²Type 65: 7.0

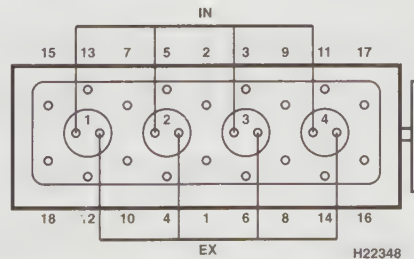
FX4S 2.7 1989 to 1991

¹185x16: 2.5 / 2.5

²Type 65: 7.0



2495 cm³



2663 cm³

- Not applicable, or information not available



CHRYSLER JEEP

	Voyager 2.5 TD 1998 to 2000	Cherokee 2.5 TD 1995 to 2000	Grand Cherokee 2.5 TD 1997 to 2000	
Engine				
Engine type/code	HR 425 OHV Turbo 87kW	09B OHV Turbo 84kW	09B OHV Turbo 84kW	
Capacity (cm ³) / cylinders	2499 / 4	2499 / 4	2499 / 4	
Compression ratio / pressure	21.0 /	21.0 /	21.0 /	
Torque outputNm	0	300	300	
Oil pressureidle [running] bar	-	[3.5 to 5.0]	[3.5 to 5.0]	
Oil temperature°C	-	80	80	
Valve clearances - inlet (mm)	0.30	0: Hyd.	0: Hyd.	
- exhaust (mm)	0.30	0: Hyd.	0: Hyd.	
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	
No. 1 cylinder position	TGF	TGF	TGF	
Cooling system				
Thermostat opening temperature°C	-	80	80	
Radiator cap pressurebar	-	1.2	1.2	
Fuel system				
Idle speedrpm	850 ± 100	900 ± 25	900 ± 25	
Maximum (no load) speedrpm	4700 ± 100	4750	4750	
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	
Static timing method	Plunger travel	Plunger travel	Plunger travel	
Timing dimension.....mm	0.82 ± 0.02	0.65	0.65	
Crankshaft positionmm [°]	TDC	TDC	TDC	
Turbo type / ref / pressurebar	-	-	-	
Injection pump make	Bosch	Bosch	Bosch	
Injection pump part no	VE	VP36	VP36	
Injector Make / type	Bosch	Bosch	Bosch	
Injector part no	0 460 404 073	-	-	
Injection type	Indirect VE	Indirect VP	Indirect VP	
Injection opening pressure, New [used]...bar	125 to 138	150 to 158	150 to 158	
Glow plugs				
Maker	Bosch	Beru	Beru	
Type	0 250 201 033	642 MJ	642 MJ	
Nominal ratingV/A	-	11 / 12	11 / 12	
Brakes				
minimum friction material thickness				
Front.....mm	7.95 with backing	-	-	
Rear.....mm	-	-	-	
Tyres - Saloon / Hatch	-	225/75x15	-	
- Estate / Van.....Size	215/65x15	-	215/75x15	
Pressure - front / rear - Saloon / Hatch...bar	-	2.1 / 2.1	-	
- Estate / Vanbar	Refer to vehicle	-	2.3 / 2.3	
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[6' ± 12']	0.0	-1.8	
Camber	8' ± 25'	-0° 15'	-0° 25'	
Castor	1° 25' ± 1°	7°	7°	
King pin inclination	-	-	-	
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 25']	-	-	
Camber	0° ± 15'	-	-	



CHRYSLER JEEP

Voyager 2.5 TD
1998 to 2000

Cherokee 2.5 TD
1995 to 2000

Grand Cherokee 2.5 TD
1997 to 2000

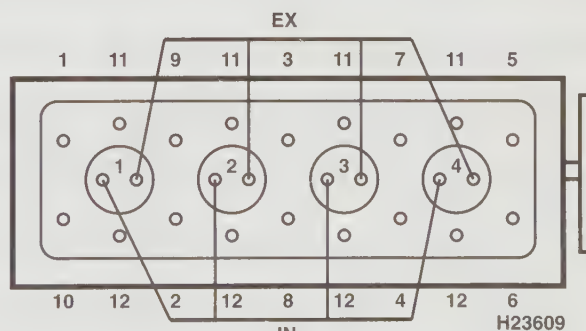
Torque wrench settings

Cylinder head - stage 1Nm	30	WSM	WSM
- stage 2Nm	+ 70°	-	-
- stage 3Nm	Warm up, allow to cool	-	-
- stage 4Nm	Slacken	-	-
- stage 5Nm	30	-	-
- stage 6Nm	+ 65°	-	-
Big-end bearings.....Nm	30 + 60° N	30 + 60° N	30 + 60° N
Main bearings.....Nm	20, 42	54, 95, 108	54, 95, 108
Crankshaft pulley boltNm	-	160	160
Camshaft pulley boltNm	-	-	-
Flywheel [driveplate] bolt.....Nm	130	68 + 60°	68 + 60°
Front hubsNm	244	237	237
Rear hubsNm	244	-	-
Wheel nuts / boltsNm	120	120	120
Glow plugsNm	25	23	23
Clutch pressure plate boltsNm	-	31	31
Injection pump sprocket.....Nm	-	86	86
Injectors.....Nm	-	70	70
Injection pump mounting boltsNm	-	28	28
Injector pipe unions.....Nm	-	25	25

Capacities

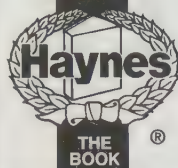
Engine oil & filter.....litres	6.0	6.5	6.5
Gearbox.....litres	2.4	3.3 Transfer: 1.0	3.3 Transfer: 1.0
Automatic transmissionlitres	-	-	-
Final drivelitres	-	1.49 Rear: 1.6	1.49 Rear: 1.6
Cooling system.....litres	-	9.5	9.5
Fuel tank.....litres	-	76	87

Notes



2499 cm³

- Not applicable, or information not available



CITROEN

	AX 14 D 1988 to 1991	AX 1.4 D 1989 to 1997	AX 1.5 D 1994 to 1997	Saxo 1.5 (Bosch) 1996 to 2000
Engine				
Engine type/code	TUD3 K9A SOHC 38kW	TUD3/Y/L K9Y SOHC 37kW	TUD5/L/Y/L3 VJZ/Y/X SOHC 42kW	TUD5/L/L3 VJZ/VJY 42/40kW
Capacity (cm ³) / cylinders	1360 / 4	1360 / 4	1527 / 4	1527 / 4
Compression ration / pressurebar	22.0 / _	22.0 / _	23.0 / _	23.0 / _
Torque outputNm	0	0	95	95
Oil pressureidle [running] bar	[4.0]	[4.0]	[4.0]	[≥4.0]
Oil temperature°C	90	90	90	90
Valve clearances - inlet (mm)	0.15	0.15 ± 0.08	0.15 ± 0.08	0.15
- exhaust (mm)	0.30	0.30 ± 0.08	0.30 ± 0.08	0.30
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	88	88	89	88
Radiator cap pressurebar	1.4	1.4	1.4	1.4
Fuel system				
Idle speedrpm	775 ± 25	775 ± 25	775 ± 25	800 ± 25
Maximum (no load) speedrpm	5500	5500	5450 ± 125	5450 ± 125
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method	Rotor lift	Rotor lift	-	-
Timing dimension.....mm	0.8	0.03	-	-
Crankshaft positionmm [°]	TDC	TDC	[14° BTDC]	[14° BTDC]
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make	Roto Diesel	Lucas	Lucas	Bosch
Injection pump part no.....	R8443B460A 91►: R8443B481	D66 R8443B971B	070 R8444B421B	VE4 / 8F2500 R611
Injector Make / type	-	CAV	CAV	Bosch
Injector part no.....	RDNOSDC 6863C	RDNOSDC 688DC	RDN 12 SDC 6849D	DNOSD 299-A / DNOSD 3026
Injection type.....	DPC TU D 100	DPC TU D 100	VJZ: R8444B421. VJY: R8444B480	Indirect VE
Injection opening pressure, New [used]...bar	125 + 5	125 + 5	130 + 5-0	120.0 ± 5.0
Glow plugs				
Maker	Bosch/Champion	Beru/Bosch	Beru/Bosch	Bosch/Beru
Type	B250 601 382 / CH147	0100 221 144 / 0250 202 001	0 100 226 188 / 0250 202 020	0 250 201 033 / 0 100 226 188
Nominal rating.....V/A	-	-	11.0 / _	11.0 / _
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	145/70x13: 155/70x13	145/70x13: 155/70x13	155/70x13	165/70x13: 165/65x14
Pressure - front / rear - Saloon / Hatch...bar	1.9 / 1.9	1.9 / 1.9	2.1 / 2.1	2.2 / 2.0
- Estate / Vanbar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-2.0 ± 1.5	-2.0 ± 1.5	-0.5 to -3.5	-1.0 to -3.0 PAS: 1.0 to 3.0
Camber	57' + 30'	-30'	-30'	-40' ± 30'
Castor	1°5' ± 30'	2°15' ± 1°	2°15' ± 1°	2°13' ± 30' PAS: 3°14'±30'
King pin inclination.....	12.58°	-	-	12°41' ± 40' PAS: 12°42'±40'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.0 ± 1.0	1.8 to 5.4	1.8 to 5.4	1.49 to 6.39
Camber	-1° ± 20'	-1°15'	-1°15'	-59' ± 20'



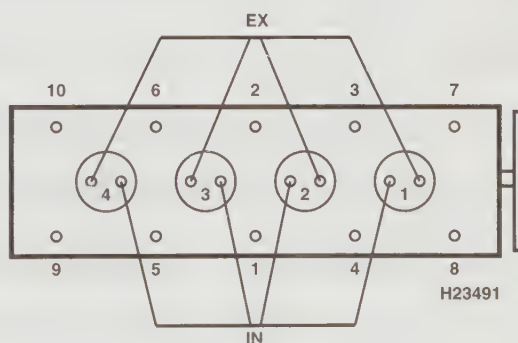
CITROEN

	AX 14 D 1988 to 1991	AX 1.4 D 1989 to 1997	AX 1.5 D 1994 to 1997	Saxo 1.5 (Bosch) 1996 to 2000
Torque wrench settings				
Cylinder head - stage 1	60 N oiled threads	20 N	Bolt length: ≤197.5mm	Bolts ≤184.4 mm below head
- stage 2	Slacken	+ 160°	40	20'
- stage 3	20	+ 160°	+ 260°	+ 260° ± 5°
- stage 4	+ 160°	-	-	-
- stage 5	+ 160°	-	-	-
- stage 6	-	-	-	-
Big-end bearings	40 N	40 N	40 N	40 N
Main bearings	20 + 45°	20 + 45°	20 + 45°	20 + 45°
Crankshaft pulley bolt	90 to 130	90 to 130	110	70 + 45°
Camshaft pulley bolt	40 to 50	40 to 50	-	40 + 20°
Flywheel [driveplate] bolt	70 LkC	70 LkC	66	65 LkC
Front hubs	250	250	250	250
Rear hubs	140	140	140	140
Wheel nuts / bolts	90	90	90	85
Glow plugs	22	22	20	25
Clutch pressure plate bolts	13	13	13	13
Injection pump sprocket	-	-	-	23
Injectors	70	70	55	70
Injection pump mounting bolts	-	-	-	25
Injector pipe unions	20	20	20	20
Capacities				
Engine oil & filter	3.75	3.75	4.75	4.75
Gearbox	2.0	2.0	2.0	2.0
Automatic transmission	-	-	-	-
Final drive	WT	WT	WT	WT
Cooling system	4.8	4.8	6.0	4.8
Fuel tank	43	43	43	45

Notes

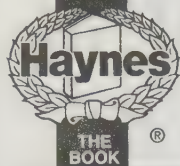
Saxo 1.5 (Bosch) 1996 to 2000

'01.99 on: 40 Nm + 300° ± 5°



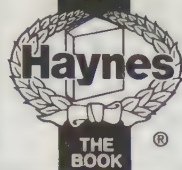
1360 cm³ / 1527 cm³

- Not applicable, or information not available



CITROEN

	Saxo 1.5 (Lucas) 1996 to 2000	Picasso 2.0 HDi 2000	ZX 1.4D (Lucas) 1995 to 1998	ZX 1.4D (Bosch) 1995 to 1998
Engine				
Engine type/code.....	TUD5/L/L3 VJZ/VJY 42/40kW	DW10TD/L3 RHY 66kW	TUD3Y/L K9Y SOHC 37kW	TUD3Y/L K9Y SOHC 37kW
Capacity (cm ³) / cylinders.....	1527 / 4	1997 / 4	1360 / 4	1360 / 4
Compression ratio / pressure.....bar	23.0 / _	17.6 / _	22.5 / _	22.5 / _
Torque output.....Nm	95	0	0	0
Oil pressure.....idle [running] bar	[≥4.0]	[4.0]	[3.5]	[3.5]
Oil temperature.....°C	90	90	80	80
Valve clearances - inlet (mm).....	0.15	-	0.15 ± 0.08	0.15 ± 0.08
- exhaust (mm).....	0.30	-	0.30 ± 0.08	0.30 ± 0.08
Injection order.....	1-3-4-2	-	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	-	FE	FE
Cooling system				
Thermostat opening temperature.....°C	88	-	88	88
Radiator cap pressure.....bar	1.4	-	1.4	1.4
Fuel system				
Idle speed.....rpm	800 ± 25	-	800 ± 50	800 ± 50
Maximum (no load) speed.....rpm	5450 ± 125	-	5100 ± 125	5100 ± 125
Smoke test/opacity.....M ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Dial gauge	-	-	-
Timing dimension.....mm	Dimension on pump	-	Dimension on pump	Dimension on pump
Crankshaft position.....mm [°]	-	-	-	-
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	Lucas	-	Lucas	Bosch
Injection pump part no.....	DPC / 8444 B425/482/660	-	TUD100 DPC 8443	TUD200 VER311
Injector Make / type.....	CAV	-	-	-
Injector part no.....	RDN 12SDC 6849	-	-	-
Injection type.....	Indirect DPC	-	DPC	VER
Injection opening pressure, New [used]...bar	130.0 ± 5.0	-	125 ± 5	-
Glow plugs				
Maker.....	Bosch/Beru	-	Beru/Bosch	Beru/Bosch
Type.....	0 250 201 033 / 0 100 226 188	-	0100 221 144 / 0250 202 001	0100 221 144 / 0250 202 001
Nominal rating.....V/A	11.0 / _	-	-	-
Brakes				
minimum friction material thickness				
Front.....mm	2.0	-	2.0	2.0
Rear.....mm	1.0	-	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	165/70x13; 165/65x14	-	-	-
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.0	-	-	-
- Estate / Van.....bar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.0 to -3.0 PAS: 1.0 to 3.0	-	-1.0 to -3.0 PAS: 1.0 to 3.0	-1.0 to -3.0 PAS: 1.0 to 3.0
Camber.....	-40' ± 30'	-	0 ± 40'	0° ± 40'
Castor.....	2°13' ± 30' PAS: 3°14'±30'	-	1°30' ± 40' PAS: 3°±40'	1°30' ± 40' PAS: 3°±40'
King pin inclination.....	12°41' ± 40' PAS: 12°42'±40	-	10°45' ± 40'	10°45' ± 40'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.49 to 6.39	-	2.5 to 6.0	2.5 to 6.0
Camber.....	-59' ± 20'	-	-1° ± 40'	-1° ± 40'



CITROEN

	Saxo 1.5 (Lucas) 1996 to 2000	Picasso 2.0 HDi 2000	ZX 1.4D (Lucas) 1995 to 1998	ZX 1.4D (Bosch) 1995 to 1998
Torque wrench settings				
Cylinder head - stage 1Nm	Bolts ≤ 184.4 mm below head	20	20'	20'
- stage 2Nm	20'	60	60	60
- stage 3Nm	$+ 260^\circ \pm 5^\circ$	$220^\circ \pm 5^\circ$	$+ 180^\circ$	$+ 180^\circ$
- stage 4Nm	-	-	-	-
- stage 5Nm	-	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	40 N	-	40 N	40 N
Main bearings.....Nm	$20 + 45^\circ$	-	$20 + 45^\circ$	$20 + 45^\circ$
Crankshaft pulley boltNm	$70 + 45^\circ$	-	90 to 130	90 to 130
Camshaft pulley boltNm	$40 + 20^\circ$	-	40 to 50	40 to 50
Flywheel [driveplate] bolt.....Nm	65 LkC	-	70 LkC	70 LkC
Front hubsNm	250	-	-	-
Rear hubsNm	140	-	-	-
Wheel nuts / boltsNm	85	-	-	-
Glow plugsNm	25	-	22	22
Clutch pressure plate boltsNm	13	-	13	13
Injection pump sprocket.....Nm	23	-	-	-
Injectors.....Nm	70	-	-	-
Injection pump mounting boltsNm	25	-	-	-
Injector pipe unions.....Nm	20	-	-	-
Capacities				
Engine oil & filter.....litres	4.75	4.5	4.25 A/C: 4.0	4.25 A/C: 4.0
Gearbox.....litres	2.0	-	1.9	1.9
Automatic transmissionlitres	-	-	2.4	2.4
Final drivelitres	WT	-	WT	WT
Cooling system.....litres	6.0	11.0	9.0	9.0
Fuel tank.....litres	45	60	56	56

Notes

Saxo 1.5 (Lucas) 1996 to 2000

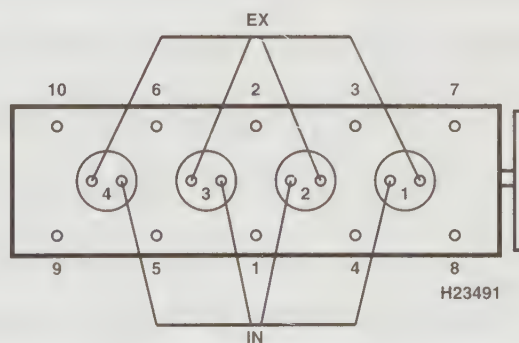
'01.99 on: 40 Nm + $300^\circ \pm 5^\circ$

ZX 1.4D (Lucas) 1995 to 1998

'Bolt length below head: ≤ 121.5 mm Bolt with guide boss: ≤ 125.5 mm

ZX 1.4D (Bosch) 1995 to 1998

'Bolt length below head: ≤ 121.5 mm Bolt with guide boss: ≤ 125.5 mm



1360 cm³ / 1527 cm³



CITROEN

	ZX 1.8D (Lucas) 1993 to 1996	ZX 1.8D (Bosch) 1993 to 1996	ZX 1.9D (Lucas) 1992 to 1996	ZX 1.9D (Bosch) 1992 to 1996
Engine				
Engine type/code.....	XUD7/L A9A SOHC 43.5kW	XUD7/L A9A SOHC 43.5kW	XUD9A/L D9B SOHC 51kW	XUD9A/L D9B SOHC 51kW
Capacity (cm ³) / cylinders.....	1769 / 4	1769 / 4	1905 / 4	1905 / 4
Compression ratio / pressure.....bar	23.0 / _	23.0 / _	23.0 / _	23.0 / _
Torque outputNm	90	90	0	90
Oil pressureidle [running] bar	[3.5]	[3.5]	[3.5]	[3.5]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0.15 ± 0.08	0.15 ± 0.08	0.15 ± 0.08	0.15 ± 0.08
- exhaust (mm).....	0.30 ± 0.08	0.30 ± 0.08	0.30 ± 0.08	0.30 ± 0.08
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	89	89	89	89
Radiator cap pressure.....bar	1.4	1.4	1.4	1.4
Fuel system				
Idle speedrpm	800 ± 50	800 ± 50	800 ± 50	800 ± 50
Maximum (no load) speedrpm	5100 ± 125	5100 ± 125	5150 ± 125	5100 ± 125
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	-	Plunger travel	-	-
Timing dimension.....mm	Dimension on pump	0.9	Dimension on pump	1.07 [AT: 0.98]
Crankshaft positionmm [°]	-	TDC [0]	-	TDC [0]
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	Lucas	Bosch	Lucas	Bosch
Injection pump part no.....	0523 B930A	523 VER171/2	XUD101 8443 B952B. 95►: B953C	VER 425/1 XUD 201
Injector Make / type.....	CAV	Bosch	CAV	Bosch
Injector part no.....	RDNOSDC 6850D	DNOSD 256/	RDNOSDC 6751D	DNOSD +299A
Injection type.....	Indirect DPC	Indirect VER	Indirect DPC	Indirect VER
Injection opening pressure, New [used]...bar	130.0 ± 5.0	130.0 ± 5.0	125.0 ± 5.0	130 ± 0 -5.0
Glow plugs				
Maker.....	Beru/Bosch	Beru/Bosch	Beru/Bosch	Beru/Bosch
Type.....	0100 221 133 / 0250 201 019	0100 221 133 / 0250 201 019	0100 221 133 / 0250 201 019	0100 221 133 / 0250 201 019
Nominal rating.....V/A	11 / 13	11 / 13	11 / 13	11 / 13
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size	175/65x14	175/65x14	175/65x15	175/65x14
- Estate / Van.....Size	-	-	-	-
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.1	2.1 2.2	2.2 / 2.1	2.2 / 2.1
- Estate / Van.....bar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.0 to -3.0 PAS: 1.0 to 3.0	-1.0 to -3.0 PAS: 1.0 to 3.0	-1.0 to -3.0 PAS: 1.0 to 3.0	-1.0 to -3.0 PAS: 1.0 to 3.0
Camber.....	0° ± 40'	0 ± 40'	0° ± 40'	0 ± 40'
Castor.....	1°30' ± 40' PAS: 3° ± 40'	1°30' ± 40' PAS: 3° ± 40'	1°30' ± 40' PAS: 3° ± 40'	1°30' ± 40' PAS: 3° ± 40'
King pin inclination.....	10°45' ± 40'	10°45' ± 40'	10°45' ± 40'	10°45' ± 40'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.5 to 6.0	2.5 to 6.0	2.5 to 6.0	2.5 to 6.0
Camber.....	-1° ± 40'	-1° ± 40'	-1° ± 40'	-1° ± 40'



CITROEN

	ZX 1.8D (Lucas) 1993 to 1996	ZX 1.8D (Bosch) 1993 to 1996	ZX 1.9D (Lucas) 1992 to 1996	ZX 1.9D (Bosch) 1992 to 1996
Torque wrench settings				
Cylinder head - stage 1Nm	20'	20'	20'	20'
- stage 2Nm	60	60	60	70
- stage 3Nm	+ 180°	+ 180°	+ 180°	+ 140°
- stage 4Nm	-	-	-	-
- stage 5Nm	-	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	35, 70	35, 70	70	70
Crankshaft pulley boltNm	40 + 60°	40 + 60°	40 + 60°	40 + 60°
Camshaft pulley boltNm	35	35	35	35
Flywheel [driveplate] bolt.....Nm	50	50	50	50
Front hubsNm	320	320	320	320
Rear hubs.....Nm	190	190	190	190
Wheel nuts / boltsNm	90	90	90	90
Glow plugsNm	22	22	22	22
Clutch pressure plate boltsNm	20	20	20	20
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	90	90	90	90
Injection pump mounting boltsNm	-	-	-	-
Injector pipe unions.....Nm	20	20	20	20
Capacities				
Engine oil & filter.....litres	4.25 A/C: 4.0	4.25 A/C: 4.0	4.25 A/C: 4.0	4.25 A/C: 4.0
Gearbox.....litres	1.9	1.9	1.9	1.9
Automatic transmissionlitres	2.4	2.4	2.4	2.4
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	9.0	9.0	8.5	8.5
Fuel tank.....litres	56	56	56	56

Notes

ZX 1.8D (Lucas) 1993 to 1996

'Bolt length below head: ≤121.5 mm Bolt with guide boss: ≤125.5 mm

ZX 1.8D (Bosch) 1993 to 1996

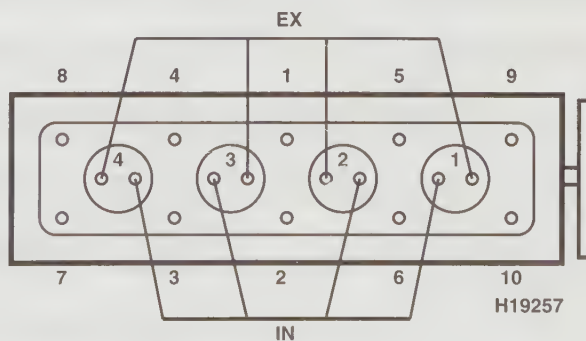
'Bolt length below head: ≤121.5 mm Bolt with guide boss: ≤125.5 mm

ZX 1.9D (Lucas) 1992 to 1996

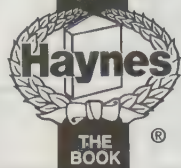
'Bolt length below head: ≤121.5 mm Bolt with guide boss: ≤125.5 mm

ZX 1.9D (Bosch) 1992 to 1996

'Bolt length below head: ≤121.5 mm Bolt with guide boss: ≤125.5 mm



1769 cm³ / 1905 cm³



CITROEN

	ZX 1.9D (Lucas) 1995 to 1998	ZX 1.9D (Bosch) 1995 to 1996	ZX 1.9D Turbo (Bosch) 1992 to 1996	ZX 1.9D Turbo (Lucas) 1992 to 1998
Engine				
Engine type/code.....	XUD9A/L D9B SOHC 51kW	XUD9AY/L3 DJY SOHC 50kW	XUD9TE/L D8A Turbo 67.5kW	XUD9T/L D8A Turbo 67.5kW
Capacity (cm ³) / cylinders.....	1905 / 4	1905 / 4	1905 / 4	1905 / 4
Compression ration / pressurebar	23.0 / _	23.0 / _	21.8 / _	21.8 / _
Torque outputNm	90	90	202	202
Oil pressureidle [running] bar	[3.5]	[3.5]	[4.9]	[4.9]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0.15 ± 0.08	0.15 ± 0.08	0.15 ± 0.08	0.15 ± 0.08
- exhaust (mm).....	0.30 ± 0.08	0.30 ± 0.08	0.30 ± 0.08	0.30 ± 0.08
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	89	89	83	83
Radiator cap pressurebar	1.4	1.4	1.4	1.4
Fuel system				
Idle speedrpm	800 ± 50	800 ± 50	800 ± 50	800 ± 50
Maximum (no load) speedrpm	5150 ± 125	5150 ± 125	5050 ± 125	5050 ± 125
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Dial gauge	Plunger travel	Plunger travel	Dial gauge
Timing dimension.....mm	Dimension on pump	0.9	0.66	Dimension on pump
Crankshaft positionmm [°]	-	TDC [0]	TDC [0]	TDC [0]
Turbo type / ref / pressurebar	-	-	KKK K14 / Garrett T2 ¹	KKK K14 / Garrett T2 ¹
Injection pump make.....	Lucas	Bosch	Bosch	Lucas
Injection pump part no.....	XUD101 8443 3B980A	VER 425/6 XUD 211	VER 445 XUD 203	XUD 103
Injector Make / type.....	CAV	Bosch	Bosch	CAV
Injector part no.....	RDNOSDC 6751D	DNOSD 299A	DNOSD 299	-
Injection type.....	Indirect DPC	Indirect VER	Indirect VER	Indirect
Injection opening pressure, New [used]...bar	125.0 ± 5.0	130.0 +0 -5.0	175.0 +5.0 -0	175.0 +5.0 -0
Glow plugs				
Maker.....	Beru/Bosch	Beru/Bosch	Beru/Bosch	Beru/Bosch
Type.....	0100 221 133 / 0250 201 019	0100 221 133 / 0250 201 019	0100 226 186 / 0250 201 039	0100 226 186 / 0250 201 039
Nominal rating.....V/A	11 / 12	11 / 12	11 / 12	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175/65x14	175/65x14	175/65x14	175/70x14
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	175/70x14
- Estate / Vanbar	2.2 / 2.1	2.2 / 2.1	2.4 / 2.2	2.3 / 2.1
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.0 to -3.0 PAS: 1.0 to 3.0	-1.0 to -3.0 PAS: 1.0 to 3.0	-1.0 to -3.0 PAS: 1.0 to 3.0	-1.0 to -3.0 PAS: 1.0 to 3.0
Camber.....	0 ± 40'	0° ± 40'	0° ± 40'	0° ± 40'
Castor.....	1°30' ± 40' PAS: 3° ± 40'	1°30' ± 40' PAS: 3° ± 40'	1°30' ± 40' PAS: 3° ± 40'	1°30' ± 40' PAS: 3° ± 40'
King pin inclination.....	10°45' ± 40'	10°45' ± 40'	10°45' ± 40'	10°45' ± 40'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.5 to 6.0	2.5 to 6.0	2.5 to 6.0	2.5 to 6.0
Camber.....	-1° ± 40'	-1° ± 40'	-1° ± 40'	-1° ± 40'



CITROEN

	ZX 1.9D (Lucas) 1995 to 1998	ZX 1.9D (Bosch) 1995 to 1996	ZX 1.9D Turbo (Bosch) 1992 to 1996	ZX 1.9D Turbo (Lucas) 1992 to 1998
Torque wrench settings				
Cylinder head - stage 1Nm	20 ¹	20 ¹	20 ²	20 ²
- stage 2Nm	70	70	60	60
- stage 3Nm	+ 140°	+ 140°	20 (oiled)	+ 220°
- stage 4Nm	-	-	+ 220°	-
- stage 5Nm	-	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	70	70	70	70
Crankshaft pulley boltNm	40 + 60°	40 + 60°	40 + 51°	40 + 50°
Camshaft pulley boltNm	35	35	35	35
Flywheel [driveplate] bolt.....Nm	50	50	50	50
Front hubsNm	320	320	320	320
Rear hubsNm	190	190	190	190
Wheel nuts / boltsNm	90	90	90	90
Glow plugsNm	22	22	22	22
Clutch pressure plate boltsNm	20	20	20	20
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	90	90	90	90
Injection pump mounting boltsNm	-	-	22	22
Injector pipe unions.....Nm	20	20	20	20
Capacities				
Engine oil & filter.....litres	4.25 A/C: 4.0	4.25 A/C: 4.0	4.25 A/C: 4.0	4.25 A/C: 4.0
Gearbox.....litres	1.9	1.9	1.9	1.9
Automatic transmissionlitres	2.4	2.4	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	8.5	8.5	9.0	9.0
Fuel tank.....litres	56	56	56	56

Notes

ZX 1.9D (Lucas) 1995 to 1998

¹Bolt length below head: ≤121.5 mm Bolt with guide boss: ≤125.5 mm

ZX 1.9D (Bosch) 1995 to 1996

¹Bolt length below head: ≤121.5 mm Bolt with guide boss: ≤125.5 mm

ZX 1.9D Turbo (Bosch) 1992 to 1996

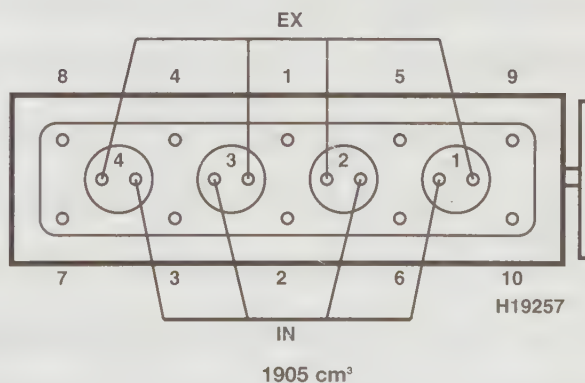
¹0.66 to 0.76 bar @ 2000 rpm

²Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤150.5 mm

ZX 1.9D Turbo (Lucas) 1992 to 1998

¹0.66 to 0.76 bar @ 2000 rpm

²Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤150.5 mm

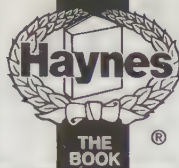


- Not applicable, or information not available



CITROEN

	ZX 1.9D Turbo (Bosch) 1995 to 1998	ZX 1.9D Turbo (Lucas) 1997 to 1998	Xsara 1.5 D (Lucas) 1998 to 2000	Xsara 1.5 D (Bosch) 1998 to 2000
Engine				
Engine type/code	XUD9TEY/L3 DHY Turbo 66kW	XUD9TEY/L3 DHY Turbo 66kW	TUD5 L3 VJZ/Y SOHC 42/40kW	TUD5 L3 VJZ/Y SOHC 42/40kW
Capacity (cm ³) / cylinders	1905 / 4	1905 / 4	1527 / 4	1527 / 4
Compression ratio / pressure	21.8 / _	21.8 / _	23.0 / _	23.0 / _
Torque outputNm	202	202	95	95
Oil pressureidle [running] bar	[4.9]	[4.9]	[4.0 @ 4000]	[4.0 @ 4000]
Oil temperature°C	80	80	90	90
Valve clearances - inlet (mm)	0.15 ± 0.08	0.15 ± 0.08	0.15	0.15
- exhaust (mm)	0.30 ± 0.08	0.30 ± 0.08	0.30	0.30
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	83	83	88	88
Radiator cap pressurebar	1.4	1.4	1.4	1.4
Fuel system				
Idle speedrpm	800 ± 50	800 ± 50	800 ± 50 ^a	800 ± 50 ^a
Maximum (no load) speedrpm	5050 ± 125	5050 ± 125	5450 ± 125	5450 ± 125
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Plunger travel	Plunger travel	Refer to wsm	-
Timing dimension.....mm	0.66	0.66	-	-
Crankshaft positionmm [°]	TDC [0]	TDC [0]	-	-
Turbo type / ref / pressurebar	-	KKK K14 /Garrett T2 ^a	-	-
Injection pump make	Bosch	Lucas	Lucas	Bosch
Injection pump part no.....	VER 445 XUD 210	XUD 110	R8444B662B	VE4 537
Injector Make / type	Bosch	-	-	-
Injector part no.....	DNOSD 299	-	RDN 12SDC 6849 E	-
Injection type.....	Indirect VER	Indirect	Indirect DPC	Indirect VER
Injection opening pressure, New [used]...bar	175.0 +5.0 -0	175	130 to 135	115 to 125
Glow plugs				
Maker	Beru/Bosch	Beru/Bosch	Beru/Champion	Bosch
Type	0100 226 186 / 0250 201 039	0100 226 186 / 0250 201 039	A 0 100 226 188 / C625 037 00	0 250 201 033
Nominal rating.....V/A	11 / 12	11 / 12	11 / 9	11 / 9
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	1.0	1.0	2.0	2.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175/70x14	175/70x14	175/65x14: 185/65x14	175/65x14: 185/65x14
Pressure - front / rear - Saloon / Hatch...bar	2.3 / 2.1	2.3 / 2.1	2.2 / 2.2: 2.2 / 2.3	2.2 / 2.2: 2.3 / 2.2
- Estate / Vanbar	-	-	2.2 / 2.3	2.3 / 2.2
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.0 to -3.0 PAS: 1.0 to 3.0	-1.0 to -3.0 PAS: 1.0 to 3.0	-1.5 ± 1.0	-1.5 ± 1.0
Camber	0° ± 40'	0° ± 40'	0° ± 1°	0° ± 1°
Castor	1°30' ± 40' PAS: 3° ± 40'	1°30' ± 40' PAS: 3° ± 40'	1°30' ± 40'	1°30' ± 40'
King pin inclination.....	10°45' ± 40'	10°45' ± 40'	10°50' ± 1'	10°50' ± 1'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.5 to 6.0	2.5 to 6.0	4.5 ± 1.0	4.5 ± 1.0
Camber	-1° ± 40'	-1° ± 40'	-1°20' ± 40'	-1°20' ± 40'



CITROEN

	ZX 1.9D Turbo (Bosch) 1995 to 1998	ZX 1.9D Turbo (Lucas) 1997 to 1998	Xsara 1.5 D (Lucas) 1998 to 2000	Xsara 1.5 D (Bosch) 1998 to 2000
Torque wrench settings				
Cylinder head - stage 1.....Nm	20 ¹	20 ²	40 ¹	40 ¹
- stage 2.....Nm	60	60	+ 260°	+ 260°
- stage 3.....Nm	+ 220°	+ 220°	-	-
- stage 4.....Nm	-	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	40 N	40 N
Main bearings.....Nm	70	70	20 + 45°	20 + 45°
Crankshaft pulley bolt.....Nm	40 + 50°	40 + 50°	110	110
Camshaft pulley bolt.....Nm	35	35	80	80
Flywheel [driveplate] bolt.....Nm	50	50	48	48
Front hubs.....Nm	320	320	250 N	250 N
Rear hubs.....Nm	190	190	WSM	WSM
Wheel nuts / bolts.....Nm	90	90	85	85
Glow plugs.....Nm	22	22	20 ³	25
Clutch pressure plate bolts.....Nm	20	20	15	15
Injection pump sprocket.....Nm	50	50	23	23
Injectors.....Nm	90	90	70	70
Injection pump mounting bolts.....Nm	22	22	25	25
Injector pipe unions.....Nm	20	20	20	20
Capacities				
Engine oil & filter.....litres	4.25 A/C: 4.0	4.25 A/C: 4.0	4.75	4.75
Gearbox.....litres	1.9	1.9	2.0	2.0
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	9.0	9.0	8.8	8.8
Fuel tank.....litres	56	56	54	54

Notes

ZX 1.9D Turbo (Bosch) 1995 to 1998

¹Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤150.5 mm

ZX 1.9D Turbo (Lucas) 1997 to 1998

¹0.66 to 0.76 bar @ 2000 rpm

²Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤150.5 mm

Xsara 1.5 D (Lucas) 1998 to 2000

¹Bolt length below head ≤184.4 mm

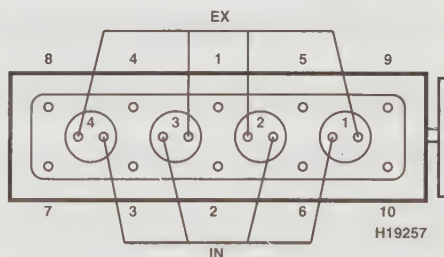
²With A/C: 825 ± 25 rpm

³Champion: 12 Nm

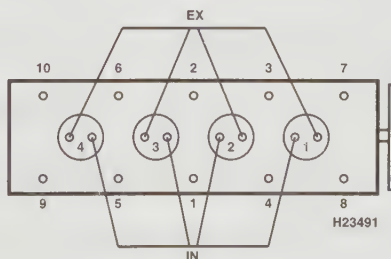
Xsara 1.5 D (Bosch) 1998 to 2000

¹Bolt length ≤184.4 mm below head

²With A/C: 825 ± 25 rpm



1905 cm³



1527 cm³

- Not applicable, or information not available



CITROEN

	Xsara 1.8 D 1998 to 1999	Xsara 1.9 D (Bosch) 1998 to 2000	Xsara 1.9 D (Lucas) 1998 to 2000	Xsara 1.9 SD 1998 to 2000
Engine				
Engine type/code	XUD7 L3 A9A SOHC 43kW	XUD9A L3 DJY SOHC 50kW	XUD9A L3 DJY SOHC 50kW	XUD9BSD L4 DHV Turbo 55kW
Capacity (cm ³) / cylinders	1769 / 4	1905 / 4	1905 / 4	1905 / 4
Compression ratio / pressure	23.0 / _	23.0 / _	23.0 / _	21.1 / _
Torque output	100 Nm	110	110	135
Oil pressureidle [running] bar	[4.0]	[4.0]	[4.0]	[4.0]
Oil temperature°C	90	90	90	90
Valve clearances - inlet (mm)	0.20 ± 0.5	0.15 ± 0.5	0.15 ± 0.5	0.15 ± 0.8
- exhaust (mm)	0.40 ± 0.5	0.40 ± 0.5	0.40 ± 0.5	0.30 ± 0.8
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	89 to 95	89 to 95	89 to 95	89 to 95
Radiator cap pressure	1.4	1.4	1.4	1.4
Fuel system				
Idle speedrpm	850 ± 50	850 ± 50	850 ± 50	875 ± 25 N/A
Maximum (no load) speedrpm	5100 ± 125	5150 ± 125	5150 ± 125	5100 ± 125
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	3.0
Static timing method.....	Dial gauge	Plunger travel	Peg	Rotor lift
Timing dimension.....mm	Dimension on pump	0.9	Dimension on pump	0.74
Crankshaft positionmm [°]	TDC	TDC	TDC	TDC
Turbo type / ref / pressure	-	-	-	KKK 0.3 to 0.4 bar
Injection pump make	Lucas	Bosch	Lucas	Bosch
Injection pump part no.....	683B	XUD LP05 R753	XUD 211	VE 4/8F 2300 R 753
Injector Make / type	-	-	-	-
Injector part no.....	-	-	-	KCA 17 S 42
Injection type.....	XUD LP04	Indirect	XUD LP05	VE4/8F 2300 R753 ECU control
Injection opening pressure, New [used]...bar	-	140	140	165 ± 5
Glow plugs				
Maker	-	Bosch	Bosch	Beru
Type	-	0 502 010 33	0 502 010 33	0100226326
Nominal rating.....V/A	-	-	-	11 / 7.5
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	2.0	2.0	2.0	2.0
Tyres - Saloon / Hatch				
Size	175/65x14	175/65x14	175/65x14	175/65x14
- Estate / Van.....Size	185/65x14	185/65x14	185/65x14	185/65x14
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.2	2.2 / 2.2	2.2 / 2.2	2.2 / 2.2
- Estate / Vanbar	2.3 / 2.3	2.3 / 2.3	2.3 / 2.3	2.3 / 2.3
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.5 ± 1.0	-1.5 ± 1.0	-1.5 ± 1.0	-1.5 ± 1.0
Camber	0° ± 1°	0° ± 1°	0° ± 1°	0° ± 1°
Castor	1°30' ± 40'	1°30' ± 40'	1°30' ± 40'	1°30' ± 40'
King pin inclination.....	10°50' ± 1'	10°50' ± 1'	10°50' ± 1'	10°50' ± 1'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	4.5 ± 1.0	4.5 ± 1.0	4.5 ± 1.0	4.5 ± 1.0
Camber	-1°20' ± 40'	-1°20' ± 40'	-1°20' ± 40'	-1°20' ± 40'



CITROEN

	Xsara 1.8 D 1998 to 1999	Xsara 1.9 D (Bosch) 1998 to 2000	Xsara 1.9 D (Lucas) 1998 to 2000	Xsara 1.9 SD 1998 to 2000
Torque wrench settings				
Cylinder head - stage 1.....Nm	20 ¹	20 ¹	20 ¹	20 ¹
- stage 2.....Nm	60	60	60	60
- stage 3.....Nm	+ 180°	+ 180°	+ 180°	+ 180°
- stage 4.....Nm	-	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	70	70	70	15 + 60°
Crankshaft pulley bolt.....Nm	40 + 51°	40 + 51°	40 + 51°	40 + 51°
Camshaft pulley bolt.....Nm	45	45	45	45
Flywheel [driveplate] bolt.....Nm	48	48	48	48
Front hubs.....Nm	M24: 320 M20: 250	M24: 320 M20: 250	M24: 320 M20: 250	M24: 320 M20: 250
Rear hubs.....Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	85	85	85	85
Glow plugs.....Nm	25	25	25	22
Clutch pressure plate bolts.....Nm	15	15	15	15
Injection pump sprocket.....Nm	-	50	50	50
Injectors.....Nm	90	90	90	90
Injection pump mounting bolts.....Nm	25	-	-	-
Injector pipe unions.....Nm	-	25	25	20
Capacities				
Engine oil & filter.....litres	4.75	4.25	4.25	4.25 A/C: 4.75
Gearbox.....litres	2.0	2.0	2.0	2.0
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	6.5	6.5	6.5	6.5
Fuel tank.....litres	54	54	54	54

Notes

Xsara 1.8 D 1998 to 1999

¹Bolt length below head: ≤125.5 mm Bolt without guide boss: ≤121.5 mm

Xsara 1.9 D (Bosch) 1998 to 2000

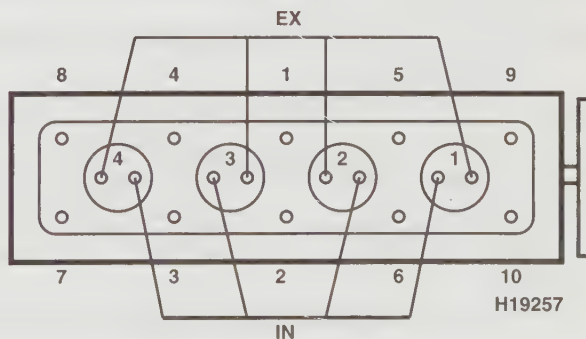
¹Bolt length below head: ≤121.5 mm Bolt with guide boss: ≤125.5 mm

Xsara 1.9 D (Lucas) 1998 to 2000

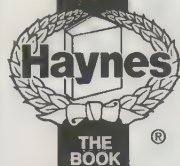
¹Bolt length below head: ≤121.5 mm Bolt with guide boss: ≤125.5 mm

Xsara 1.9 SD 1998 to 2000

¹ Bolt length below head ≤125.5 mm



1769 cm³ / 1905 cm³



CITROEN

	Xsara 1.9 TD 1998 to 2000	Xsara 1.9 D 1998 to 2000	Xsara 2.0 HDi 1999 to 2000	BX 17 1987 to 1993
Engine				
Engine type/code.....	XUD9TE L3 DHY Turbo 66kW	DW8 WJZ SOHC EGR 51kW	DW10TD/L3 RHY SOHC 66kW	XUD7 161A SOHC 44kW
Capacity (cm ³) / cylinders.....	1905 / 4	1868 / 4	1997 / 4	1769 / 4
Compression ratio / pressure.....bar	21.8 / _	23.0 / _	17.6 / ≥30 ± 5	23.0 / _
Torque outputNm	196	125	205	0
Oil pressureidle [running] bar	2.5 [4.9 @ 4000]	1.8 [3.7 @ 2000]	[3.8]	[3.5]
Oil temperature°C	90	80	80	80
Valve clearances - inlet (mm).....	0.20 ± 0.5	0.15 ± 0.05	0: Hyd.	0.15 ± 0.08
- exhaust (mm).....	0.40 ± 0.5	0.30 ± 0.05	0: Hyd.	0.30 ± 0.08
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	89 to 95	83	83	81 4.87 ▶: 88
Radiator cap pressure.....bar	1.4	1.4	1.4	1.0
Fuel system				
Idle speedrpm	850 ± 50	800 ± 25 ²	-	750 ± 50
Maximum (no load) speedrpm	5150 ± 125	5350 ± 125	-	5100 ± 125
Smoke test/opacityM ⁻¹ %	3.0	3.0	2.0	2.5
Static timing method.....	Peg	Peg	-	Dial gauge
Timing dimension.....mm	Dimension on pump	0.58 ± 0.04 ⁴	-	Dimension on pump
Crankshaft positionmm [°]	TDC	-	-	[TDC hole]
Turbo type / ref / pressure.....bar	KKK 03 / Garrett GT15 ²	-	-	-
Injection pump make.....	Lucas	Bosch	Bosch	Roto Diesel
Injection pump part no.....	XUD 110	-	EDC 15C2	R8443B264F
Injector Make / type.....	-	-	Bosch	Roto Diesel
Injector part no.....	-	KCA 20S106 ⁵	-	RDNOSDC 6850 C
Injection type.....	R8445B 081A	VE4 / 537	Direct EDC 15C2	Indirect DPC 052
Injection opening pressure, New [used]...bar	150	120 ⁸	200 to 1350	115 ± 5
Glow plugs				
Maker.....	Bosch	Beru/Champion	Bosch/Champion	Bosch
Type.....	0 100 226 186	0100226371 / CH185	0250 202 032 / CH170	0 250 201 019
Nominal rating.....V/A	-	-	-	-
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	2.0	2.0	2.0	2.0
Tyres - Saloon / Hatch.....Size	175/65x14	175/65x14	175/65x14	165/70x14
- Estate / Van.....Size	185/65x14	185/65x14	185/65x14	165/70x14
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.2	2.2 / 2.2	2.2 / 2.2	2.0 / 2.0
- Estate / Van.....bar	2.3 / 2.3	2.3 / 2.3	2.3 / 2.3	2.3 / 2.5
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.5 ± 1.0	-1.5 ± 1.0	-1.5 ± 1.0	0 to -3.0
Camber.....	0° ± 1°	0° ± 1°	0° ± 1°	0° ± 30'
Castor.....	1°30' ± 40'	1°30' ± 40'	1°30' ± 40'	2° ± 35'
King pin inclination.....	10°50' ± 1'	10°50' ± 1'	10°50' ± 1°	11°58'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	4.5 ± 1.0	4.5 ± 1.0	4.5 ± 1.0	1.6 to 5.0
Camber.....	-1°20' ± 40'	-1°20' ± 40'	-1°20' ± 40	-9' ± 20' 88 ▶: -1° ± 20'



CITROEN

	Xsara 1.9 TD 1998 to 2000	Xsara 1.9 D 1998 to 2000	Xsara 2.0 HDi 1999 to 2000	BX 17 1987 to 1993
Torque wrench settings				
Cylinder head - stage 1	20 ¹	20 ⁴	20 ¹	30 N
- stage 2	60	60	60	70
- stage 3	+ 220°	+ 180°	+ 220°	+ 120°
- stage 4	-	-	-	-
- stage 5	-	-	-	-
- stage 6	-	-	-	-
Big-end bearings	20 + 70° N	20 + 70° N	20 + 70° N	50 N
Main bearings	15 + 60°	70	25 + 60°	70
Crankshaft pulley bolt	40 + 51°	40 + 60°	197	150 LkC
Camshaft pulley bolt	45	43	43	35
Flywheel [driveplate] bolt	48	48 N	48	50 LkC
Front hubs	M24: 320 M20: 250	M24: 320 M20: 250	320 M20: 250	270
Rear hubs	WSM	WSM	WSM	270
Wheel nuts / bolts	85	85	85	80 Alloy: 90
Glow plugs	25	25	25	22
Clutch pressure plate bolts	15	20	-	22
Injection pump sprocket	50	23	-	50
Injectors	90	90	-	90
Injection pump mounting bolts	22	20	-	18
Injector pipe unions	20	25	-	20
Capacities				
Engine oil & filter	4.25 A/C: 4.0	4.75	4.5 A/C: 4.5	5.0
Gearbox	2.0	2.0	2.0	2.0
Automatic transmission	-	-	-	-
Final drive	WT	WT	WT	WT
Cooling system	6.5	9.0	7.0	6.5
Fuel tank	54	54	54	52

Notes

Xsara 1.9 TD 1998 to 2000

¹Bolt length below head: ≤146.5 mm Bolt with guide

boss: ≤150.5 mm

²0.66 to 0.76 bar @ 2000 rpm

Xsara 1.9 D 1998 to 2000

¹Lucas Varity DPC pump available as alternative

²With A/C: 875 ± 25

³Lucas: 142 to 149

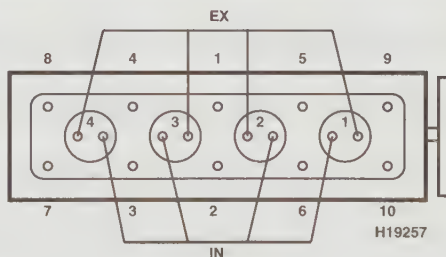
⁴Bolt length ≤125.5 mm below head

⁵or Lucas LRC6736001

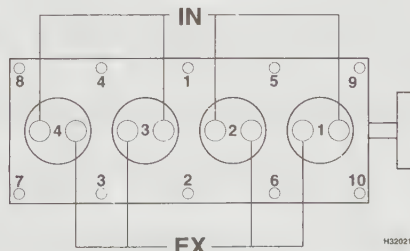
⁶Lucas: Dimension on pump

Xsara 2.0 HDi 1999 to 2000

¹ Bolt length ≤133.3 mm below head

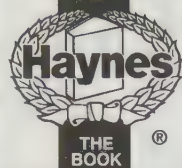


1769 cm³ / 1905 cm³



1868 cm³ / 1997 cm³

- Not applicable, or information not available



CITROEN

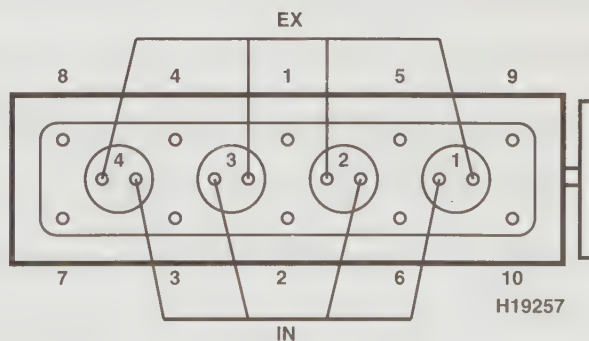
	BX 17 1987 to 1993	BX 17 Turbo 1988 to 1993	BX 17 Turbo 1988 to 1993	BX 19 1987 to 1994
Engine				
Engine type/code	XUD7 161A SOHC 44kW	XUD7TE A8A SOHC Turbo 66kW	XUD7TE A8A SOHC Turbo 66kW	XUD9A D9B SOHC 51kW
Capacity (cm ³) / cylinders	1769 / 4	1769 / 4	1769 / 4	1905 / 4
Compression ratio / pressurebar	23.0 / _	22.0 / _	22.0 / _	23.0 / _
Torque outputNm	0	0	0	0
Oil pressureidle [running] bar	[3.5]	[3.4]	[3.4]	[3.5]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.15 ± 0.08	0.15 ± 0.08	0.15 ± 0.08	0.15 ± 0.08
- exhaust (mm)	0.30 ± 0.08	0.30 ± 0.08	0.30 ± 0.08	0.30 ± 0.08
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	81	88	88	88
Radiator cap pressurebar	1.0	1.0	1.0	1.0
Fuel system				
Idle speedrpm	750 ± 50	750 ± 50	750 ± 50	750 ± 50
Maximum (no load) speedrpm	5100 ± 150	4800 ± 100	-	5100 ± 150
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Dial gauge	Dial gauge	Dial gauge	Dial gauge
Timing dimension.....mm	0.9 ABDC	Dimension on pump	0.8 ABDC	Dimension on pump
Crankshaft positionmm [°]	TDC peg	[TDC hole]	TDC peg	[TDC hole]
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make	Bosch	Roto Diesel	Bosch	Roto Diesel
Injection pump part no.....	VE R171.1	R8443B451B	R8443B451B	R8443B380A
Injector Make / type	Bosch	Roto Diesel	Bosch	Roto Diesel
Injector part no.....	DNOSD 256	RDNOSDC 6862 C	DNOSD 289	RDNOSDC 6751 C
Injection type.....	Indirect VER	Indirect DPC 058	Indirect VE R 316	Indirect DPC 057
Injection opening pressure, New [used]...bar	130 ± 5 -0	130 ± 5	130 ± 5	125 ± 5
Glow plugs				
Maker	Bosch	Bosch	Bosch	Bosch
Type	0 250 201 019	0 250 201 019	0 250 201 019	0 250 201 019
Nominal rating.....V/A	-	-	-	-
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	1.0	2.0	2.0	2.0
Tyres - Saloon / Hatch.....Size	165/70x14	165/70x14	165/70x14	165/70x14
- Estate / Van.....Size	165/70x14	165/70x14	165/70x14	165/70x14
Pressure - front / rear - Saloon / Hatch...bar	2.0 / 2.0	2.0 / 2.0	2.0 / 2.0	2.0 / 2.0
- Estate / Vanbar	2.3 / 2.5	2.3 / 2.5	2.3 / 2.5	2.3 / 2.5
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 to -3.0	0 to -3.0	0 to -3.0	0 to -3.0
Camber	0° ± 30'	0° ± 30'	0° ± 30'	0° ± 30'
Castor	2° ± 35'	2° ± 35'	2° ± 35'	2° ± 35'
King pin inclination.....	11°58'	11°58'	11°58'	11°58'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.6 to 5.0	1.6 to 5.0	1.6 to 5.0	1.6 to 5.0
Camber	-9' ± 20' 88 ▶: -1° ± 20'	-1° ± 20'	-1° ± 20'	-1° ± 20'



CITROEN

	BX 17 1987 to 1993	BX 17 Turbo 1988 to 1993	BX 17 Turbo 1988 to 1993	BX 19 1987 to 1994
Torque wrench settings				
Cylinder head - stage 1Nm	30 N	30 N	30 N	30 N
- stage 2Nm	70	70	70	70
- stage 3Nm	+ 120°	+ 120°	+ 120°	+ 120°
- stage 4Nm	-	-	-	-
- stage 5Nm	-	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	50 N	50 N	50 N	50 N
Main bearings.....Nm	70	70	70	70
Crankshaft pulley boltNm	150 LkC	150 LkC	150 LkC	150 LkC
Camshaft pulley boltNm	35	35	35	35
Flywheel [driveplate] bolt.....Nm	50 LkC	50 LkC	50 LkC	50 LkC
Front hubsNm	270	270	270	270
Rear hubsNm	270	270	270	270
Wheel nuts / boltsNm	80 Alloy: 90	80 Alloy: 90	80 Alloy: 90	80 Alloy: 90
Glow plugsNm	22	22	22	22
Clutch pressure plate boltsNm	22	22	22	22
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	90	90	90	90
Injection pump mounting boltsNm	18	18	18	18
Injector pipe unions.....Nm	20	20	20	20
Capacities				
Engine oil & filter.....litres	5.0	5.0	5.0	5.0
Gearbox.....litres	2.0	2.0	2.0	2.0
Automatic transmissionlitres	-	-	-	6.0
Final drivelitres	WT	WT	WT	WT
Cooling system.....litres	6.5	6.5	6.5	6.5
Fuel tank.....litres	52	66	66	52

Notes



1769 cm³ / 1905 cm³



CITROEN

	BX 19 1988 to 1994	Xantia 1.9D (Lucas) 1993 to 1996	Xantia 1.9D (Bosch) 1993 to 1996	Xantia 1.9D (Bosch) 1995 to 1996
Engine				
Engine type/code	XUD9A D9B SOHC 51kW	XUD9A/L D9B SOHC 51kW	XUD9A/L D9B SOHC 51kW	XUD9A/Y DJY SOHC 50kW
Capacity (cm ³) / cylinders	1905 / 4	1905 / 4	1905 / 4	1905 / 4
Compression ration / pressure	23.0 / _	23.0 / _	23.0 / _	23.0 / _
Torque outputNm	0	120	120	120
Oil pressureidle [running] bar	[3.5]	[3.5]	[3.5]	[3.5]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.15 ± 0.08	0.15 ± 0.08	0.15 ± 0.08	0.15 ± 0.08
- exhaust (mm)	0.30 ± 0.08	0.30 ± 0.08	0.30 ± 0.08	0.30 ± 0.08
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	88	89	89	89
Radiator cap pressurebar	1.0	1.4	1.4	1.4
Fuel system				
Idle speedrpm	750 ± 50	800 ± 50	800 ± 50	800 ± 50
Maximum (no load) speedrpm	5100 ± 150	5150 ± 125	5100 ± 125	5100 ± 125
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method	Dial gauge	Dial gauge	Plunger travel	Plunger travel
Timing dimension.....mm	0.9 ABDC	Dimension on pump	1.07 [AT: 0.98]	1.07 [AT: 0.98]
Crankshaft positionmm [°]	TDC peg	TDC [0]	TDC [0]	TDC [0]
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make	Bosch	Lucas	Bosch	Bosch
Injection pump part no.....	-	XUD101 8443 B952B. 95: B953C	VER 425/ XUD 201	VER 425/ XUD 211
Injector Make / type	Bosch	CAV	Bosch	Bosch
Injector part no.....	DNOSD 287 +	RDNOSDC 6751D	DNOSD +299A	DNOSD +299A
Injection type.....	Indirect VER 272.2	Indirect	Indirect	Indirect
Injection opening pressure, New [used]...bar	130 +5 -0	125.0 ± 5.0	130.0 +5.0 -0	130.0 +5.0 -0
Glow plugs				
Maker	Bosch	Beru/Bosch	Beru/Bosch	Beru/Bosch
Type	0 250 201 019	0100 221 133 / 0250 201 019'	0100 221 133 / 0250 201 019	0100 221 133 / 0250 201 019
Nominal rating.....V/A	-	11 /	11 /	11 /
Brakes				
minimum friction material thickness				
Front.....mm	2.0	3.0	3.0	3.0
Rear.....mm	2.0	2.0	2.0	2.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	165/70x14	175/70x14	175/70x14	175/70x14
Pressure - front / rear - Saloon / Hatch...bar	2.0 / 2.0	2.3 / 2.1	2.3 / 2.1	2.3 / 2.1
- Estate / Vanbar	2.3 / 2.5	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 to -3.0	0 to -3.0	0 to -3.0	0 to -3.0
Camber	0° ± 30'	0° ± 30'	0° ± 30'	0° ± 30'
Castor	2° ± 35'	1° ± 30' PAS/96: 3° ± 30'	1° ± 30' PAS/96: 3° ± 30'	1° ± 30' PAS/96: 3° ± 30'
King pin inclination.....	11°58'	13°20' ± 30' 96: 13°15' ± 35'	13°20' ± 30' 96: 13°15' ± 35'	13°20' ± 30' 96: 13°15' ± 35'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.6 to 5.0	1.0 to 6.0	1.0 to 6.0	1.0 to 6.0
Camber	-1° ± 20'	-1°15' ± 20'	-1°15' ± 20'	-1°15' ± 20'



CITROEN

	BX 19 1988 to 1994	Xantia 1.9D (Lucas) 1993 to 1996	Xantia 1.9D (Bosch) 1993 to 1996	Xantia 1.9D (Bosch) 1995 to 1996
Torque wrench settings				
Cylinder head - stage 1Nm	30 N	20 ²	20 ¹	20 ¹
- stage 2Nm	70	60	60	60
- stage 3Nm	+ 120°	+ 180°	+ 180°	+ 180°
- stage 4Nm	-	-	-	-
- stage 5Nm	-	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	50 N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	70	70	70	70
Crankshaft pulley boltNm	150 LkC	40 + 60°	40 + 60°	40 + 60°
Camshaft pulley boltNm	35	35	35	35
Flywheel [driveplate] bolt.....Nm	50 LkC	50	50	50
Front hubsNm	270	320	320	320
Rear hubsNm	270	280	280	280
Wheel nuts / boltsNm	80 Alloy: 90	90	90	90
Glow plugsNm	22	Bosch: 25 Beru: 20	Bosch: 25 Beru: 20	Bosch: 25 Beru: 20
Clutch pressure plate boltsNm	22	20	20	20
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	90	90	90	90
Injection pump mounting boltsNm	18	22	22	22
Injector pipe unions.....Nm	20	25	20	20
Capacities				
Engine oil & filter.....litres	5.0	4.2 A/C: 4.0	4.2 A/C: 4.0	4.25 A/C: 4.0
Gearbox.....litres	2.0	1.9	1.9	1.9
Automatic transmissionlitres	6.0	2.4	2.4	2.4
Final drivelitres	WT	WT	WT	WT
Cooling system.....litres	6.5	7.5 A/C: 8.5	7.5 A/C: 8.5	7.5 A/C: 8.5
Fuel tank.....litres	52	65	65	65

Notes

Xantia 1.9D (Lucas) 1993 to 1996

*AT: 0100 226 186 / 0250 201 039

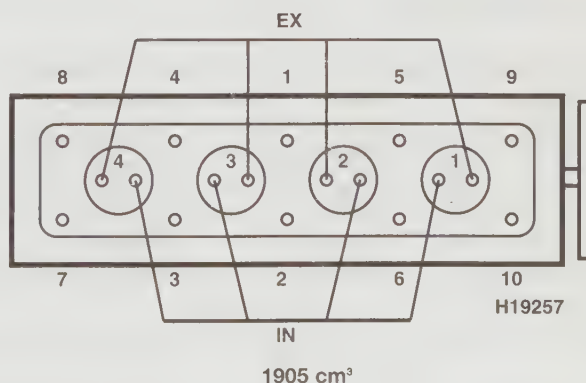
*Bolt length below head: ≤121.5 mm Bolt with guide boss: ≤125.5 mm

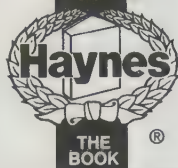
Xantia 1.9D (Bosch) 1993 to 1996

*Bolt length below head: ≤121.5 mm Bolt with guide boss: ≤125.5 mm

Xantia 1.9D (Bosch) 1995 to 1996

*Bolt length below head: ≤121.5 mm Bolt with guide boss: ≤125.5 mm





CITROEN

	Xantia 1.9D Turbo 1993 to 1996	Xantia 1.9D Turbo 1995 to 1996	Xantia 1.9D Turbo 1996 to 2000	Xantia 1.9D LPT Turbo 1997 to 2000
Engine				
Engine type/code.....	XUD9TF/L D8B OHC Turbo 67kW	XUD9TF/Y DHX OHC Turbo 66kW	XUD9BTF/Y/L3 DHX Turbo 65kW	XUD9SD/L3 DHW LP Turbo 55kW
Capacity (cm ³) / cylinders.....	1905 / 4	1905 / 4	1905 / 4	1905 / 4
Compression ratio / pressure.....bar	21.8 / _	21.8 / _	23.0 / _	21.1 / _
Torque outputNm	202	202	197	135
Oil pressureidle [running] bar	[4.9]	[4.9]	[4.9]	[4.0 @ 4000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0.15 ± 0.08	0.15 ± 0.08	0.15 ± 0.08	0.15 ± 0.08
- exhaust (mm).....	0.30 ± 0.08	0.30 ± 0.08	0.30 ± 0.08	0.30 ± 0.08
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	89	89	89	83
Radiator cap pressurebar	1.4	1.4	1.4	1.40
Fuel system				
Idle speedrpm	800 ± 50	800 ± 50	800 ± 50	800 ± 50 A/C: 850 ± 50
Maximum (no load) speedrpm	5100 ± 80	5100 ± 80	5100 ± 80	5150 ± 125
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Dial gauge
Timing dimension.....mm	0.66	0.66	0.66	Dimension on pump
Crankshaft positionmm [°]	TDC [0]	TDC [0]	TDC [0]	TDC [0]
Turbo type / ref / pressure.....bar	KKK K14 / Garrett T2'	KKK K14 / Garrett T2'	KKK K14 / Garrett T2'	KKK 0.6 bar
Injection pump make.....	Bosch	Bosch	Bosch	Lucas
Injection pump part no.....	VER 445/2 XUD 203	VER 445/2 XUD 203	VP20 AS3.1 XUD BC02	XUDLP06
Injector Make / type.....	Bosch	Bosch	Bosch	CAV
Injector part no.....	DNOSD 299	DNOSD 299	-	RDN12 3DC 6895
Injection type.....	VER	VER	VP20	XUD LP06 791B / 711B
Injection opening pressure, New [used]...bar	175.0 +5.0 -0	175.0 +5.0 -0	175	135.0
Glow plugs				
Maker.....	Beru/Bosch	Beru/Bosch	Beru/Bosch	Beru/Bosch
Type.....	0100 226 186 / 0250 201 039	0100 226 186 / 0250 201 039	0100 226 186 / 0250 201 039	0100 226 186 / 0250 201 033
Nominal rating.....V/A	11 /	-	-	-
Brakes				
minimum friction material thickness				
Front.....mm	3.0 Break: 2.0	3.0 Break: 2.0	3.0 Break: 2.0	3.0 Break: 2.0
Rear.....mm	2.0	2.0	2.0	2.0
Tyres - Saloon / Hatch.....Size	185/65x14: 195/55x15	185/65x14: 195/55x15	185/65x14: 195/55x15	185/65x14
- Estate / Van.....Size	185/65x15	185/65x15	185/65x15	185/65x14
Pressure - front / rear - Saloon / Hatch...bar	Refer to car	Refer to car	Refer to car	2.3 / 2.1
- Estate / Van.....bar	Refer to car	Refer to car	Refer to car	Refer to car
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 to -3.0	0 to -3.0	0 to -3.0	0 to -3.0
Camber.....	0° ± 30'	0° ± 30'	0° ± 30'	0° ± 30'
Castor.....	3° ± 30'	3° ± 30'	3° ± 30'	3° ± 30'
King pin inclination.....	13°20' ± 30' 96►: 13°15'±35'	13°20' ± 30' 96►: 13°15'±35'	13°20' ± 30' 96►: 13°15'±35'	13°20' ± 30' 96►: 13°15'±35'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 to 6.0	1.0 to 6.0	1.0 to 6.0	1.0 to 6.0
Camber.....	-1°15' ± 20'	-1°15' ± 20'	-1°15' ± 20'	-1°15' ± 20'



CITROEN

	Xantia 1.9D Turbo 1993 to 1996	Xantia 1.9D Turbo 1995 to 1996	Xantia 1.9D Turbo 1996 to 2000	Xantia 1.9D LPT Turbo 1997 to 2000
Torque wrench settings				
Cylinder head - stage 1	Nm 20 ²	20 ²	20 ²	20 ¹
- stage 2	Nm 60	60	60	60
- stage 3	Nm + 220°	+ 220°	+ 220°	+ 180°
- stage 4	Nm -	-	-	-
- stage 5	Nm -	-	-	-
- stage 6	Nm -	-	-	-
Big-end bearings	Nm 20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings	Nm 70	70	70	70
Crankshaft pulley bolt	Nm 40 + 60°	40 + 60°	40 + 51°	40 + 60°
Camshaft pulley bolt	Nm -	35	35	35
Flywheel [driveplate] bolt	Nm 50	50	50	50
Front hubs	Nm 320	320	320	320
Rear hubs	Nm 280	280	280	280
Wheel nuts / bolts	Nm 90	90	90	90
Glow plugs	Nm Bosch: 25 Beru: 20	Bosch: 25 Beru: 20	Bosch: 25 Beru: 20	Bosch: 25 Beru: 20
Clutch pressure plate bolts	Nm 20	20	20	20
Injection pump sprocket	Nm 50	50	50	50
Injectors	Nm 90	90	90	90
Injection pump mounting bolts	Nm 22	22	22	22
Injector pipe unions	Nm 20	20	20	20
Capacities				
Engine oil & filter	litres 4.25 A/C: 4.0	4.25 A/C: 4.0	4.25 A/C: 4.0	4.25 A/C: 4.0
Gearbox	litres 1.9	1.9	1.9	1.9
Automatic transmission	litres -	-	-	-
Final drive	litres WT	WT	WT	WT
Cooling system	litres 9.0	9.0	9.0	9.0
Fuel tank	litres 65	65	65	65

Notes

Xantia 1.9D Turbo 1993 to 1996

¹0.66 to 0.76 bar @ 2000 rpm

²Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤150.5 mm

Xantia 1.9D Turbo 1995 to 1996

¹0.66 to 0.76 bar @ 2000 rpm

²Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤150.5 mm

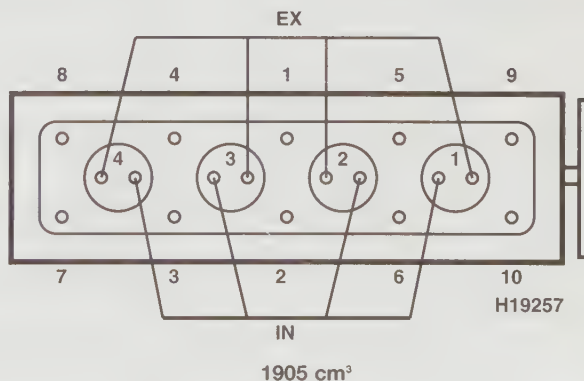
Xantia 1.9D Turbo 1996 to 2000

¹0.66 to 0.76 bar @ 2000 rpm

²Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤150.5 mm

Xantia 1.9D LPT Turbo 1997 to 2000

¹Bolt length below head: ≤125.5 mm





CITROEN

	Xantia 2.0 HDi 1998 to 2000	Xantia 2.0 HDi 1999 to 2000	Xantia 2.1D Turbo 1996 to 1999	XM 2.1D Turbo 1989 to 1995
Engine				
Engine type/code.....	DW10ATED RHZ Turbo 80kW	DW10TD RHY SOHC 66kW	XUD11BTE/Y/L3 P8C SOHC 80kW	XUD11ATE/L P8A Turbo 80kW
Capacity (cm ³) / cylinders.....	1997 / 4	1997 / 4	2088 / 4	2088 / 4
Compression ratio / pressurebar	17.6 / $\geq 30 \pm 5$	17.6 / $\geq 30 \pm 5$	21.8 / _	21.5 / _
Torque outputNm	250	205	250	250
Oil pressureidle [running] bar	[3.8]	[3.8]	[4.9]	[4.0]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	83	83	89	85 AT: 80
Radiator cap pressurebar	1.4	1.4	1.4	1.4
Fuel system				
Idle speedrpm	800 \pm 50	800 \pm 50	800 \pm 50	700 \pm 50
Maximum (no load) speedrpm	5100 \pm 80	5100 \pm 80	5100 \pm 80	5150 \pm 125
Smoke test/opacityM ⁻¹ %	2.0	2.0	2.5	2.5
Static timing method.....	Refer to wsm	Refer to wsm	-	Dial gauge
Timing dimension.....mm	Computer controlled	Computer controlled	ECU controlled	Dimension on pump
Crankshaft positionmm [°]	-	-	-	[TDC hole]
Turbo type / ref / pressurebar	-	-	Garrett TB0251 ¹	-
Injection pump make	Bosch	Bosch	Lucas	Roto Diesel
Injection pump part no.	-	EDC 15C2	EPIC XUD LC01	R8443 B740A ²
Injector Make / type	-	Bosch	-	Roto Diesel
Injector part no.	-	9625542580	-	RDN 12 SDC 6874C
Injection type.....	EDC 15C2 Direct	Direct EDC 15C2	EPIC	Indirect DPC 062
Injection opening pressure, New [used]...bar	200 to 1350	200 to 1350	150	150 \pm 5
Glow plugs				
Maker	Bosch/Champion	Bosch/Champion	Beru/Bosch	Bosch
Type	0250 202 032 / CH170	0250202032 / CH170	0100 226 186 / 0250 201 039	0250 201 019
Nominal rating.....V/A	-	-	-	-
Brakes				
minimum friction material thickness				
Front.....mm	3.0 Break: 2.0	3.0	3.0 Break: 2.0	3.0
Rear.....mm	2.0	2.0	2.0	2.0
Tyres - Saloon / Hatch.....Size	205/60x15	205/60x15	205/60x15	195/65x15: 205/65x15
- Estate / Van.....Size	205/60x15	205/60x15	205/60x15	195/65x15: 205/65x15
Pressure - front / rear - Saloon / Hatch...bar	Refer to car	Refer to vehicle	Refer to car	2.2 / 1.9 95►: 2.3 / 1.9
- Estate / Vanbar	Refer to car	Refer to vehicle	Refer to car	2.4 / 2.4 AT: 2.3 / 2.3
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 to -3.0	0 to -3.0	0 to -3.0	0 to -3.0
Camber	0° \pm 30'	0° \pm 30'	0° \pm 30'	0° \pm 30' ³
Castor	3° \pm 30'	3° \pm 30'	3° \pm 30'	2°30' \pm 30'
King pin inclination.....	13°20' \pm 30' 96►: 13°15' \pm 35'	13°20' \pm 30'	13°20' \pm 30' 96►: 13°15' \pm 35'	13°14'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 to 6.0	1.0 to 6.0	1.0 to 6.0	0.5 to 6.5
Camber	-1°15' \pm 20'	-1°15' \pm 20'	-1°15' \pm 20'	50' \pm 20'



CITROEN

	Xantia 2.0 HDi 1998 to 2000	Xantia 2.0 HDi 1999 to 2000	Xantia 2.1D Turbo 1996 to 1999	XM 2.1D Turbo 1989 to 1995
Torque wrench settings				
Cylinder head - stage 1.....Nm	20 ¹	20 ¹	Bolt length: ≤146.5mm OR...	70 ⁶
- stage 2.....Nm	60	60	Pilot section type: ≤151.5mm	+ 140°
- stage 3.....Nm	+ 220° ± 5°	+ 220°	60	Warm up, allow to cool
- stage 4.....Nm	-	-	+ 180°	Slacken
- stage 5.....Nm	-	-	-	70
- stage 6.....Nm	-	-	-	+ 140°
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	25 + 60°	25 + 60°	15 + 60°	15 + 60°
Crankshaft pulley bolt.....Nm	-	-	70 + 60°	70 + 60°
Camshaft pulley bolt.....Nm	43	43	43	43
Flywheel [driveplate] bolt.....Nm	48	48	48 N [43]	50 N
Front hubs.....Nm	320	320	320	320
Rear hubs.....Nm	280	280	280	275
Wheel nuts / bolts.....Nm	90	90	90	90
Glow plugs.....Nm	Bosch: 25 Beru: 20	20	Bosch: 25 Beru: 20	22
Clutch pressure plate bolts.....Nm	20	20	20	20
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	30	30	90	90
Injection pump mounting bolts.....Nm	22.5	25	20	18
Injector pipe unions.....Nm	20	20	25	25
Capacities				
Engine oil & filter.....litres	4.5 A/C: 4.25	4.5 A/C: 4.25	5.25 A/C: 4.75	6.0
Gearbox.....litres	1.8	1.8	1.8	1.85
Automatic transmission.....litres	-	-	-	2.0
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	8.5 A/C: 11.0	8.5 A/C: 11.0	9.0	10.0
Fuel tank.....litres	65	65	65	80

Notes

Xantia 2.0 HDi 1998 to 2000

¹Bolt length below head: ≤133.3 mm

Xantia 2.0 HDi 1999 to 2000

¹Bolt length ≤133.3 mm below head

Xantia 2.1D Turbo 1996 to 1999

¹0.9 ± 0.1 bar @ 2500 rpm

XM 2.1D Turbo 1989 to 1995

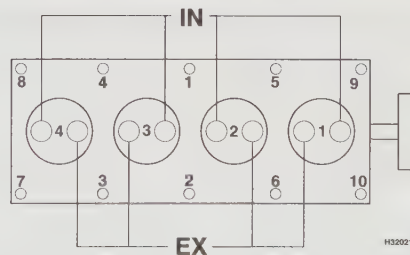
¹Or Condiesel

²Or 742A / 744B / 745B / 748E. 91►: B640

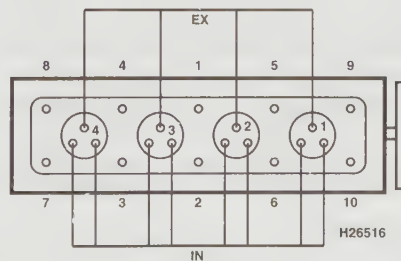
³Hydractive suspension: 15' ± 30'

⁴Hydractive suspension: 13'±28'

⁵Bolt length ≤146.8 mm below head

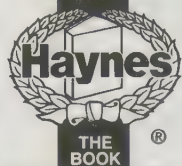


1997 cm³



2088 cm³

- Not applicable, or information not available



CITROEN

	XM 2.1D 1989 to 1991	XM 2.1D Turbo 1994 to 1996	XM 2.1D Turbo 1995 to 1999	XM 2.1D Turbo 1995 to 1996
Engine				
Engine type/code	XUD11A P9A SOHC 12V 60kW	XUD11ATE/L P8B Turbo 80kW	XUD11ATE/Y PHZ Turbo 80kW	XUD11BTE/L P8C Turbo 80kW
Capacity (cm ³) / cylinders	2138 / 4	2088 / 4	2088 / 4	2088 / 4
Compression ratio / pressurebar	22.5 / _	21.5 / _	21.5 / _	21.5 / _
Torque outputNm	0	250	250	250
Oil pressureidle [running] bar	[4.0]	[2.5]	[2.5]	[2.5]
Oil temperature°C	80	100	100	100
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	85	85 AT: 80	85 AT: 80	85 AT: 80
Radiator cap pressurebar	1.4	1.4	1.4	1.4
Fuel system				
Idle speedrpm	675 ± 25	775 ± 25	775 ± 25	750 ± 25
Maximum (no load) speedrpm	5150 ± 125	5150 ± 125	5150 ± 125	5100 ± 75
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method	Dial gauge	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	Dimension on pump	0.88	0.88	0.88
Crankshaft positionmm [°]	[TDC hole]	TDC [0]	TDC [0]	TDC [0]
Turbo type / ref / pressurebar	-	-	0.7 to 0.9 bar @ 3500 rpm	Mitsubishi TD04-11B [†]
Injection pump make	Roto Diesel	Bosch	Bosch	Lucas
Injection pump part no.....	R8443 B730A [‡]	VE4/9F 2150 R474	VE4/9F 2150 R474	XUD 11P01 R8640 A042A
Injector Make / type	Roto Diesel	Bosch	Bosch	CAV
Injector part no.....	RDN 12 SDC 6872C	DNOSD 299	DNOSD 299	RDNOSD 6751H [†]
Injection type.....	Indirect DPC 061	VE4/9F	VE4/9F	XUD
Injection opening pressure, New [used]...bar	130 ± 5	175.0 ± 5.0	175.0 ± 5.0	150.0 ± 5.0
Glow plugs				
Maker	Bosch	Beru/Bosch	Beru/Bosch	Beru/Bosch
Type	0250 201 019	0100 221 133 / 0250 202 019	0100 221 133 / 0250 202 019	0100 221 133 / 0250 202 019
Nominal rating.....V/A	-	-	11 / 12	-
Brakes				
minimum friction material thickness				
Front.....mm	3.0	3.0	3.0	3.0
Rear.....mm	2.0	2.0	2.0	2.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175/70x15: 185/65x15	195/65x15: 205/65x15	195/65x15: 205/65x15	195/65x15: 205/65x15
Pressure - front / rear - Saloon / Hatch...bar	195/65x15	195/65x15: 205/65x15	195/65x15: 205/65x15	195/65x15: 205/65x15
- Estate / Vanbar	2.4 / 1.9 185/65: 2.3 / 1.9	2.2 / 1.9 95: 2.3 / 1.9	2.3 / 1.9	2.2 / 1.9 95: 2.3 / 1.9
	Refer to car	2.4 / 2.4 AT: 2.3 / 2.3	2.4 / 2.4 AT: 2.3 / 2.3	2.4 / 2.4 AT: 2.3 / 2.3
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 to -3.0	0 to -3.0	0 to -3.0	0 to -3.0
Camber	0° ± 30' ³	0° ± 30' ¹	0° ± 30' ¹	0° ± 30' ²
Castor	2°30' ± 30'	2°30' ± 30'	2°30' ± 30'	2°30' ± 30'
King pin inclination.....	13°14' ⁴	13°14' ²	13°14' ²	13°14' ³
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.5 to 6.5	0.5 to 6.5	0.5 to 6.5	0.5 to 6.5
Camber	50' ± 20'	50' ± 20'	50' ± 20'	50' ± 20'



CITROEN

	XM 2.1D 1989 to 1991	XM 2.1D Turbo 1994 to 1996	XM 2.1D Turbo 1995 to 1999	XM 2.1D Turbo 1995 to 1996
Torque wrench settings				
Cylinder head - stage 1.....Nm	70 N	Bolt length ≤146.5 mm ⁴	Bolt length ≤146.5 mm ³	Bolt length ≤151.5 mm
- stage 2.....Nm	+ 140°	70	70 ⁴	60
- stage 3.....Nm	-	+ 150°	+ 150°	+ 180°
- stage 4.....Nm	-	-	warm-up, allow to cool	-
- stage 5.....Nm	-	-	- 90°	-
- stage 6.....Nm	-	-	70 + 150°	-
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	70	70	15 + 60°	15 + 60°
Crankshaft pulley bolt.....Nm	70 + 60°	70 + 60°	70 + 60°	70 + 60°
Camshaft pulley bolt.....Nm	43	43	43	43
Flywheel [driveplate] bolt.....Nm	50	48 N	48 N	48 N
Front hubs.....Nm	320	320	320	320
Rear hubs.....Nm	275	275	275	275
Wheel nuts / bolts.....Nm	90	90	90	90
Glow plugs.....Nm	22	22	22	22
Clutch pressure plate bolts.....Nm	20	20	20	20
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	90	90	90	90
Injection pump mounting bolts.....Nm	18	18	18	18
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	6.0	5.75 A/C: 5.5 ³	5.75 A/C: 5.5	5.0 A/C: 4.5
Gearbox.....litres	1.8	1.85	1.85	1.85
Automatic transmission.....litres	-	2.7	2.7	2.7
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	9.6	11.4 to 12.0	11.4 to 12.0	11.4 to 12.0
Fuel tank.....litres	80	80	80	80

Notes

XM 2.1D 1989 to 1991

¹Or Condiesel

²Or B731A / B732B / B733C / B735D. 91►: B631

³Hydractive suspension: 15' ± 30'

⁴Hydractive suspension: 13°28'

XM 2.1D Turbo 1994 to 1996

¹Hydractive suspension: 15' ± 30'

²Hydractive suspension: 13°28'

³►: 4.25 A/C: 4.0

⁴Bolt with guide boss: ≤151.5 mm

XM 2.1D Turbo 1995 to 1999

¹Hydractive suspension: 15' ± 30'

²Hydractive suspension: 13°28'

³Bolts with guide boss: 151.5 mm

⁴Bolts with guide boss: 60 + 180°

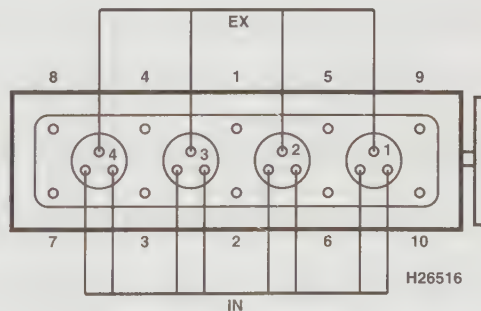
XM 2.1D Turbo 1995 to 1996

¹No 4: RDNOSDC 6751H

²Hydractive suspension: 15' ± 30'

³Hydractive suspension: 13°28'

⁴0.9 ± 0.1 bar : 3000 rpm

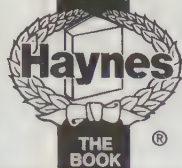


2088 cm³ / 2138 cm³



CITROEN

	XM 2.1D Turbo 1996 to 1999	XM 2.1D 1994 to 1996	XM 2.1D Turbo 1998 to 1999	XM 2.5D Turbo 1994 to 1996
Engine				
Engine type/code	XUD11BTE/L3 P8C Turbo 80kW	XUD11A/L PJZ SOHC 12V 60kW	XUD11BTE/L4 P8C Turbo 80kW	DK5ATE/L THY Turbo 94kW
Capacity (cm ³) / cylinders	2088 / 4	2138 / 4	2088 / 4	2446 / 4
Compression ratio / pressurebar	21.5 / _	22.5 / _	21.5 / _	21.0 / _
Torque outputNm	250	0	250	217
Oil pressureidle [running] bar	[2.5]	[2.5]	[2.5]	[3.0]
Oil temperature°C	100	100	100	90
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	85 AT: 80	85	85 AT: 80	85 AT: 80
Radiator cap pressurebar	1.4	1.4	1.4	1.4
Fuel system				
Idle speedrpm	750 ± 25	725 ± 25	750 ± 25	750 ± 50
Maximum (no load) speedrpm	5100 ± 75	5150 ± 125	5100 ± 75	5150
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	3.0
Static timing method.....	Plunger travel	Dial gauge	Plunger travel	Refer to wsm
Timing dimension.....mm	0.88	Dimension on pump	0.88	-
Crankshaft positionmm [°]	TDC [0]	[TDC hole]	TDC [0]	-
Turbo type / ref / pressurebar	Mitsubishi TD04-11B ¹	-	Mitsubishi TD04-11B ¹	Garrett T2 0.3 bar @ 3000 rpm
Injection pump make	Lucas	Lucas	Lucas	Bosch
Injection pump part no.....	EPIC XUD 11CO1 R04010011B	DPC 061 R8443 B962A	EPIC XUD 11CO1 R04010011B	96: MSA11 3.6 0281001212/3
Injector Make / type	CAV	CAV	-	Bosch
Injector part no.....	RDNOSD 6751H ¹	RDNOSDC 6872D	-	DNOSD 312. No 3: 316
Injection type.....	EPIC	DPC 061	EPIC	VP36 VER520 type 535
Injection opening pressure, New [used]...bar	150.0 ± 5.0	130.0 ± 5.0	150.0 ± 5.0	170.0 ± 5.0 -0
Glow plugs				
Maker	Beru/Bosch	Beru/Bosch	Beru/Bosch	Beru/Bosch
Type	0100 221 133 / 0250 202 019	0100 221 133 / 0250 202 019	0100 221 133 / 0250 202 019	0100 226 186 / 0250 201 033
Nominal ratingV/A	-	-	-	-
Brakes				
minimum friction material thickness				
Front.....mm	3.0	3.0	3.0	3.0
Rear.....mm	2.0	2.0	2.0	2.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/65x15: 205/65x15	195/65x15	195/65x15: 205/65x15	205/65x15
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 1.9 95►: 2.3 / 1.9	2.2 / 2.0	2.3 / 1.9	2.3 / 1.9
- Estate / Vanbar	2.4 / 2.4 AT: 2.3 / 2.3	2.4 / 2.4	2.4 / 2.4 AT: 2.3 / 2.3	2.3 / 2.3
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 to -3.0	0 to -3.0	0 to -3.0	0 to -3.0
Camber	0° ± 30' ²	0° ± 30' ¹	0° ± 30'	0° ± 30' ¹
Castor	2°30' ± 30'	2°30' ± 30'	2°30' ± 30'	2°30' ± 30'
King pin inclination.....	13°14' ¹³	13°14' ¹²	13°14'	13°14' ¹²
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.5 to 6.5	0.5 to 6.5	0.5 to 6.5	0.5 to 6.5
Camber	50' ± 20'	50' ± 20'	50' ± 20'	50' ± 20'



CITROEN

	XM 2.1D Turbo 1996 to 1999	XM 2.1D 1994 to 1996	XM 2.1D Turbo 1998 to 1999	XM 2.5D Turbo 1994 to 1996
Torque wrench settings				
Cylinder head - stage 1.....Nm	Bolt length ≤151.5 mm	70°	Bolt length ≤151.5 mm	Bolt length no 1 to 14 ≤153.5
- stage 2.....Nm	60	+ 150°	60	No 15 to 22: ≤162.5 mm
- stage 3.....Nm	+ 180°	-	+ 180°	No 1 to 14: 50
- stage 4.....Nm	-	-	-	No 15 to 22: 35
- stage 5.....Nm	-	-	-	+ 120 ± 5°
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	15 + 60°	70	15 + 60°	15 + 60°
Crankshaft pulley bolt.....Nm	70 + 60°	70 + 60°	70 + 60°	70 + 60°
Camshaft pulley bolt.....Nm	43	43	43	43
Flywheel [driveplate] bolt.....Nm	48 N	50 N	50 N	50
Front hubs.....Nm	320	320	320	320
Rear hubs.....Nm	275	275	275	275
Wheel nuts / bolts.....Nm	90	90	90	90
Glow plugs.....Nm	22	22	22	Beru: 20 Bosch: 25
Clutch pressure plate bolts.....Nm	20	20	20	20
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	90	90	90	90
Injection pump mounting bolts.....Nm	18	18	18	18
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	5.0 A/C: 4.5	5.75 A/C: 5.5	5.0 A/C: 4.5	8.0
Gearbox.....litres	1.85	1.9	1.85	2.2
Automatic transmission.....litres	2.7	-	2.7	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	11.4 to 12.0	9.8	11.4 to 12.0	13.2
Fuel tank.....litres	80	80	80	80

Notes

XM 2.1D Turbo 1996 to 1999

¹No 4: RDNOSDC 6751H

²Hydractive suspension: 15' ± 30'

³Hydractive suspension: 13°28'

⁴0.9 ± 0.1 bar @ 3000 rpm

XM 2.1D 1994 to 1996

¹Hydractive suspension: 15' ± 30'

²Hydractive suspension: 13°28'

³Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤150.5 mm

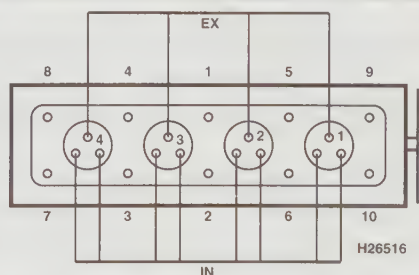
XM 2.1D Turbo 1998 to 1999

¹0.9 ± 0.1 bar @ 3000 rpm

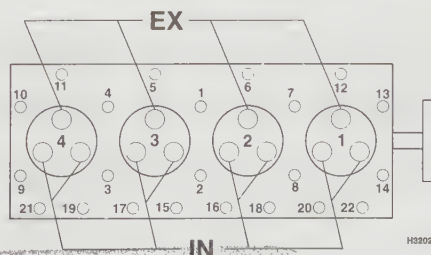
XM 2.5D Turbo 1994 to 1996

¹Hydractive suspension: 15' ± 30'

²Hydractive suspension: 13°28'

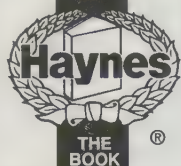


2088 cm³ / 2138 cm³



2446 cm³

- Not applicable, or information not available



CITROEN

	XM 2.5D Turbo 1996 to 1999	Evasion/Synergie 1.9TD 1994 to 2000	Evasion/Synergie 1.9TD 1994 to 2000	Evasion/Synergie 2.0 HDi 1999 to 2000
Engine				
Engine type/code.....	DK5ATE/L3 THY Turbo 94kW	XUD9TF/L/W2 D8B Turbo 67kW	XUD9BTF/Y/L3 DHX Turbo 66kW	DW10ATED RHZ SOHC 80kW
Capacity (cm ³) / cylinders.....	2446 / 4	1905 / 4	1905 / 4	1997 / 4
Compression ration / pressurebar	21.0 / _	21.8 / _	21.8 / _	17.6 / $\geq 30 \pm 5$
Torque outputNm	217	196	196	250
Oil pressureidle [running] bar	[3.0]	[4.9]	[4.9]	[3.8]
Oil temperature°C	90	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0.15 \pm 0.08	0.15 \pm 0.08	0: Hyd.
- exhaust (mm)	0: Hyd.	0.30 \pm 0.08	0.30 \pm 0.08	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	85 AT: 80	89	89	83
Radiator cap pressurebar	1.4	1.4	1.4	1.4
Fuel system				
Idle speedrpm	750 \pm 50	800 \pm 50	800 \pm 50 A/C: 850 \pm 50	800 \pm 50 A/C: 850 \pm 50
Maximum (no load) speedrpm	5150	5100 \pm 80	5100 \pm 80	5100 \pm 80
Smoke test/opacityM ⁻¹ %	3.0	2.5	2.5	2.5
Static timing method.....	Refer to wsm	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	-	0.66	0.57	0.57
Crankshaft positionmm [°]	-	TDC	TDC	TDC
Turbo type / ref / pressurebar	Garrett T2 0.3 bar @ 3000rpm	KKK K14 / Garrett T2 ¹	KKK K14 / Garrett T2 ¹	-
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	96: MSA11 7.6 0281001336	VER 445/2 XUD203	XUD BP02 R601/1/2	EDC 15C2
Injector Make / type	Bosch	Bosch	Bosch	Bosch
Injector part no.....	DNOSD 312, No 3: 316	DNDOSD 299	DNDOSD 299	-
Injection type.....	VP36 VER520 type 535	Indirect	VP20	EDC 15C2 Direct
Injection opening pressure, New [used]...bar	170.0 +5.0 -0	175 +5 -0	175 +5 -0	-
Glow plugs				
Maker	Beru/Bosch	Bosch/Beru	Bosch/Beru	Bosch/Beru/Champion
Type	0100 226 186 / 0250 201 033	0 250 201 039 / 0 100 226 186	0 250 201 039 / 0 100 226 186	0250 202 032 / CH170
Nominal ratingV/A	-	11 / 9	11 / 9	-
Brakes				
minimum friction material thickness				
Front.....mm	3.0	8.5 with backing	8.5 with backing	3.0 Break: 2.0
Rear.....mm	2.0	-	-	2.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	205/65x15	205/65x15	205/65x15	205/65x15
Pressure - front / rear - Saloon / Hatch...bar	2.3 / 1.9	-	-	Refer to car
- Estate / Vanbar	2.3 / 2.3	2.3 / 2.3	2.3 / 2.3	Refer to car
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 to -3.0	0.5 to 1.5	0.5 to 1.5	0 to -3.0
Camber	0° \pm 30 ¹	0° \pm 30'	0° \pm 30'	0° \pm 30'
Castor	2°30' \pm 30'	3°30' \pm 30'	3°30' \pm 30'	3° \pm 30'
King pin inclination.....	13°14' ²	11°30' \pm 40'	11°30' \pm 40'	13°20' \pm 30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.5 to 6.5	0.5 to 1.5	0.5 to 1.5	1.0 to 6.0
Camber	50' \pm 20'	1° \pm 30'	1° \pm 30'	1°15' \pm 20'



CITROEN

	XM 2.5D Turbo 1996 to 1999	Evasion/Synergie 1.9TD 1994 to 2000	Evasion/Synergie 1.9TD 1994 to 2000	Evasion/Synergie 2.0 HDi 1999 to 2000
Torque wrench settings				
Cylinder head - stage 1.....Nm	Bolt length no 1 to 14 ≤153.5	20°	20°	20°
- stage 2.....Nm	No 15 to 22: ≤162.5 mm	60	60	60
- stage 3.....Nm	No 1 to 14: 50	+ 220°	+ 220°	+ 220° ± 5°
- stage 4.....Nm	No 15 to 22: 35	-	-	-
- stage 5.....Nm	+ 120 ± 5°	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	15 + 60°	15 + 60°	70	25 + 60°
Crankshaft pulley bolt.....Nm	70 + 60°	40 + 60°	40 + 60°	-
Camshaft pulley bolt.....Nm	43	45	45	43
Flywheel [driveplate] bolt.....Nm	50	50	50	48
Front hubs.....Nm	320	100 + 60°	100 + 60°	320
Rear hubs.....Nm	275	100 + 60°	100 + 60°	280
Wheel nuts / bolts.....Nm	90	100	100	90
Glow plugs.....Nm	Beru: 20 Bosch: 25	22	22	Bosch: 25 Beru: 20
Clutch pressure plate bolts.....Nm	20	22	20	-
Injection pump sprocket.....Nm	50	50	90	50
Injectors.....Nm	90	90	90	30
Injection pump mounting bolts.....Nm	18	22	22	22.5
Injector pipe unions.....Nm	25	20	20	20
Capacities				
Engine oil & filter.....litres	8.0	4.25 A/C: 4.0	4.75 A/C: 4.0	4.5 A/C: 4.25
Gearbox.....litres	2.2	1.85	1.85	1.85
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	13.2	9.0	9.0	8.5 A/C: 11.0
Fuel tank.....litres	80	80	80	80

Notes

XM 2.5D Turbo 1996 to 1999

¹Hydractive suspension: 15' ± 30'

²Hydractive suspension: 13°28'

Evasion/Synergie 1.9TD 1994 to 2000

¹0.66 to 0.76 bar @ 2000 rpm

²Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤150.5 mm

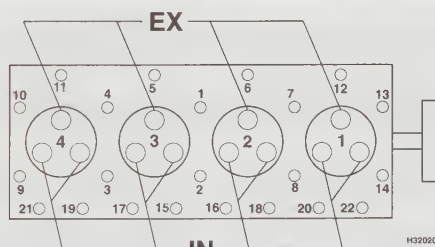
Evasion/Synergie 1.9TD 1994 to 2000

¹0.66 to 0.76 bar @ 2000 rpm

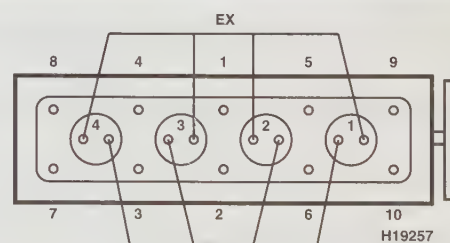
²Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤150.5 mm

Evasion/Synergie 2.0 HDi 1999 to 2000

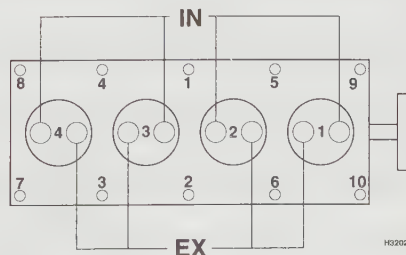
¹Bolt length below head: ≤133.3 mm



2446 cm³



1905 cm³



1997 cm³

- Not applicable, or information not available



CITROEN

	Evasion/Synergie 2.1TD 1996 to 1999	C15D Van 1984 to 1992	C15D Van 1987 to 1992	C15D Van 1993 to 1999
Engine				
Engine type/code.....	XUD11BTE/L3 P8C Turbo 80kW	XUD7 161A SOHC 44kW	XUD7 161A SOHC 44kW	XUD7/W2 161A SOHC 43kW
Capacity (cm ³) / cylinders.....	2088 / 4	1769 / 4	1769 / 4	1769 / 4
Compression ration / pressurebar	21.5 / _	23.0 / _	23.0 / _	23.0 / _
Torque outputNm	250	110	110	110
Oil pressureidle [running] bar	[4.9]	[3.0]	[3.0]	[3.0]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0.15 ± 0.08	0.15 ± 0.08	0.15 ± 0.08
- exhaust (mm)	0: Hyd.	0.30 ± 0.08	0.30 ± 0.08	0.30 ± 0.08
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	89	79 to 82	79 to 82	79 to 82
Radiator cap pressurebar	1.4	1.0	1.0	1.0
Fuel system				
Idle speedrpm	750	750 ± 50	750 ± 50	750 ± 50
Maximum (no load) speedrpm	5100 ± 75	5150 ± 125	5100 ± 125	5100 ± 125
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Plunger travel	Dial gauge	Dial gauge	Dial gauge
Timing dimension.....mm	0.66	0.3 ABDC	Dimension on pump	Dimension on pump
Crankshaft positionmm [°]	TDC	0.8 ± 0.03 [9.5]	[TDC hole]	[TDC hole]
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make	Lucas	Bosch	Roto Diesel	Roto Diesel
Injection pump part no.	R040 0A 100A	-	R8443B264F	R8443B264F
Injector Make / type	-	Bosch	Roto Diesel	Roto Diesel
Injector part no.....	-	RDNOSD 256	RDNOSDC 6850C	RDNOSDC 6850C
Injection type.....	Diesel EPIC	VER 171 or 171.1	DPC	DPC
Injection opening pressure, New [used]...bar	175 +5 -0	130 +5 -0	125 ± 5	125 ± 5
Glow plugs				
Maker	Bosch/Beru	Bosch	Bosch	Bosch
Type	0 250 201 039 / 0 100 226 186	0250 201 005	0250 201 005	0250 201 005'
Nominal rating.....V/A	-	11 / 13	11 / 13	11 / 13
Brakes				
minimum friction material thickness				
Front.....mm	8.5 with backing	2.0	2.0	2.0
Rear.....mm	-	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	205/65x15	155x13	155x13	155x13
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	2.3 / 2.3	2.3 / 2.6	2.3 / 2.6	2.3 / 2.6
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.5 to 1.5	0 to 2.0	0 to 2.0	0 to 2.0 PAS: 3.0
Camber	0° ± 30'	30' ± 30' 765kg: 41' ± 30'	30' ± 30' 765kg: 41' ± 30'	30' ± 30' 765: 41' ± 30''
Castor	3°30' ± 30'	55' ± 30' 765kg: 1°47' ± 30'	55' ± 30' 765kg: 1°47' ± 30'	55' ± 30' 765: 1°47' ± 30''
King pin inclination.....	11°30' ± 40'	8°50' ± 40' 765kg: 8°34' ± 40'	8°50' ± 40' 765kg: 8°34' ± 40'	8°50' ± 40' 765: 8°34' ± 40''
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.5 to 1.5	1.6 to 5.0	1.6 to 5.0	1.6 to 5.0
Camber	1° ± 30'	-9' ± 20'	-9' ± 20'	-9' ± 20'



CITROEN

	Evasion/Synergie 2.1TD 1996 to 1999	C15D Van 1984 to 1992	C15D Van 1987 to 1992	C15D Van 1993 to 1999
Torque wrench settings				
Cylinder head - stage 1.....Nm	Bolt length: ≤146.5mm or....	30 N ¹	30 N ¹	30 N
- stage 2.....Nm	Pilot type: ≤150.5mm	60	60	70
- stage 3.....Nm	20	Slacken	Slacken	+ 120°
- stage 4.....Nm	60	60	60	-
- stage 5.....Nm	+ 180°	Warm up, allow to cool	Warm up, allow to cool	-
- stage 6.....Nm	-	Slacken, 70	Slacken, 70	-
Big-end bearings.....Nm	20 + 70° N	50 N	50 N	50 N
Main bearings.....Nm	15 + 60°	70	70	70
Crankshaft pulley bolt.....Nm	70 + 60°	150 LkC	150 LkC	150 LkC
Camshaft pulley bolt.....Nm	43	35	35	35
Flywheel [driveplate] bolt.....Nm	50	50 LkC	50 LkC	50 LkC
Front hubs.....Nm	100 + 60°	250	250	250
Rear hubs.....Nm	100 + 60°	275	275	275
Wheel nuts / bolts.....Nm	100	60 to 80	60 to 80	60 to 80
Glow plugs.....Nm	22	22	22	22
Clutch pressure plate bolts.....Nm	-	22	22	22
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	90	90	90	90
Injection pump mounting bolts.....Nm	-	-	18	18
Injector pipe unions.....Nm	20	20	20	20
Capacities				
Engine oil & filter.....litres	4.5 A/C: 4.25 ¹	5.0	5.0	4.25
Gearbox.....litres	1.85	2.0	2.0	2.0
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	9.0	8.0	8.0	8.0
Fuel tank.....litres	80	48	48	48

Notes

Evasion/Synergie 2.1TD 1996 to 1999

¹Alloy sump: 4.0 l

C15D Van 1984 to 1992

¹9.86 l: 30, 70 + 120°

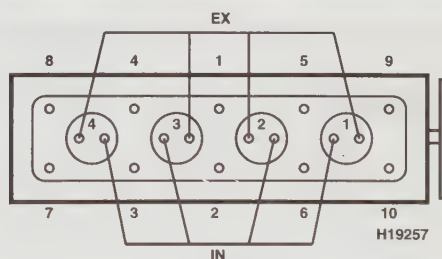
C15D Van 1993 to 1999

¹96 l: Beru 0100 226 186 / Bosch 0250 201 033

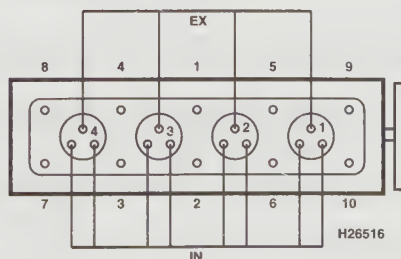
²PAS: 30° ± 30°

³PAS: 55° ± 30°

⁴PAS: 8°50' ± 40°



1769 cm³



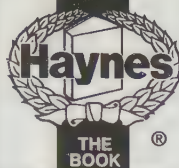
2088 cm³

- Not applicable, or information not available



CITROEN

	C15D Van 1993 to 1999	C15D Van 1999 to 2000	Dispatch / Jumpy 1.9 D 1995 to 1999	Dispatch / Jumpy 1.9 TD 1995 to 1999
Engine				
Engine type/code.....	XUD7L 161A SOHC 43kW	DW8 WJZ/C SOHC EGR 51kW	XUD9A/W2 D9B SOHC 52kW	XUD9TF/W2 D8B Turbo 67kW
Capacity (cm ³) / cylinders.....	1769 / 4	1868 / 4	1905 / 4	1905 / 4
Compression ratio / pressurebar	23.0 / ≥20	23.0 / _	23.0 /	21.8 /
Torque outputNm	110	125	120	196
Oil pressureidle [running] bar	2.5 [3.0 to 5.0 @ 4000]	1.8 [3.7 @ 2000]	[5.0 @ 4000]	[5.0 @ 4000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0.15 ± 0.08	0.15 ± 0.08	0.15 ± 0.05	0.15 ± 0.05
- exhaust (mm).....	0.30 ± 0.08	0.30 ± 0.08	0.30 ± 0.05	0.30 ± 0.05
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	79 to 82	83	83	83
Radiator cap pressurebar	1.0	1.4	1.1	1.1
Fuel system				
Idle speedrpm	800 ± 50	800 ± 25	800 to 850	800 ± 50
Maximum (no load) speedrpm	5100 ± 125	5350 ± 125	5150 ± 125	5150 ± 80
Smoke test/opacityM ⁻¹ %	2.5	2.5	3.0	2.5
Static timing method.....	Dial gauge	Plunger travel	Plunger travel	Dial gauge
Timing dimension.....mm	Dimension on pump	0.58 ± 0.04	1.07 ± 0.03	0.66
Crankshaft positionmm [°]	[TDC hole]	TDC	TDC	TDC
Turbo type / ref / pressurebar	-	-	-	KKK K14 / Garrett T2 ²
Injection pump make.....	Roto Diesel	Bosch	Bosch	Bosch
Injection pump part no.....	DPC R8443B930A	VE4 / 537 ¹	VER 425 10/11	R445
Injector Make / type.....	Roto Diesel	-	-	Bosch
Injector part no.....	RDNOSDC 6850C	KCA 20S106	DNOSD 299 A	KCA 17S42
Injection type.....	Indirect DPC	Indirect	Indirect	Indirect
Injection opening pressure, New [used]...bar	142 to 147	120 ²	130	175 to 180
Glow plugs				
Maker.....	Bosch	Beru/Champion	Bosch	Bosch
Type.....	0250 201 019	0100226371 / CH185	0 250 201 033	0 250 201 033
Nominal rating.....V/A	11 / 13	11	11 / 18	11 / 18
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	8.5 with backing	8.5 with backing
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size	-	-	-	-
- Estate / Van.....Size	155x13	155x13	195/70x14	195/70x14
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	2.3 / 2.6	2.3 / 2.6	2.5 / 2.5	3.0 / 3.0
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 to 2.0 PAS: 3.0	0 to 2.0 PAS: 3.0	1.0 to 3.0	1.0 to 3.0
Camber.....	30' ± 30' 765: 41' ± 30' ²	30' ± 30' 765: 41' ± 30' ²	0° ± 30'	0° ± 30'
Castor.....	55' ± 30' 765: 1°47' ± 30' ³	55' ± 30' 765: 1°47' ± 30' ³	1° ± 30' PAS: 3°30' ± 30'	1° ± 30' PAS: 3°30' ± 30'
King pin inclination.....	8°50' ± 40' 765: 8°34' ± 40' ⁴	8°50' ± 40' 765: 8°34' ± 40' ⁴	11°28' ± 40'	11°28' ± 40'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.6 to 5.0	1.6 to 5.0	1.0 to 3.0	1.0 to 3.0
Camber.....	-9' ± 20'	-9' ± 20'	-1° ± 30'	-1° ± 30'



CITROEN

	C15D Van 1993 to 1999	C15D Van 1999 to 2000	Dispatch / Jumpy 1.9 D 1995 to 1999	Dispatch / Jumpy 1.9 TD 1995 to 1999
Torque wrench settings				
Cylinder head - stage 1	Nm 20 N	Bolt ≤125.5mm below head	20'	20'
- stage 2	Nm 60	20	60	60
- stage 3	Nm + 180°	60	+ 180°	+ 220°
- stage 4	Nm -	+ 180°	-	-
- stage 5	Nm -	-	-	-
- stage 6	Nm -	-	-	-
Big-end bearings	Nm 20 + 70° N	20 + 70° N	40, slacken, 20 + 70° N	20 + 70° N
Main bearings	Nm 70	70	70	70
Crankshaft pulley bolt	Nm 150 LkC	40 + 60°	40 + 51°	40 + 50°
Camshaft pulley bolt	Nm 35	25 Hub: 43	45	35
Flywheel [driveplate] bolt	Nm 50 LkC	48 N	50 N LkC	50
Front hubs	Nm 250	250	100 + 60° oiled	100 + 60° oiled
Rear hubs	Nm 275	275	100 + 60°	100 + 60°
Wheel nuts / bolts	Nm 60 to 80	60 to 80	100	100
Glow plugs	Nm 22	25	18	22
Clutch pressure plate bolts	Nm 22	20	20	20
Injection pump sprocket	Nm 50	23	50	50
Injectors	Nm 90	90	90	90
Injection pump mounting bolts	Nm 18	20	-	-
Injector pipe unions	Nm 20	25	25	25
Capacities				
Engine oil & filter	litres 5.0	4.75	4.2	4.25
Gearbox	litres 2.0	2.0	1.8	1.8
Automatic transmission	litres -	-	-	-
Final drive	litres WT	WT	WT	WT
Cooling system	litres 7.5	10.5	9.0	9.0
Fuel tank	litres 48	48	80	80

Notes

C15D Van 1993 to 1999

*PAS: 30' ± 30'

*PAS: 55' ± 30'

*PAS: 8°50' ± 40'

C15D Van 1999 to 2000

*Lucas Varity DPC pump available as alternative

*Lucas: 142 to 149

*PAS: 55' ± 30'

*PAS: 8°50' ± 40'

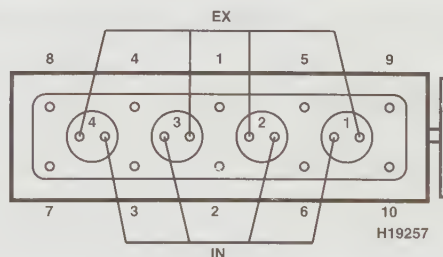
Dispatch / Jumpy 1.9 D 1995 to 1999

*Bolt length below head: ≤124.5 mm

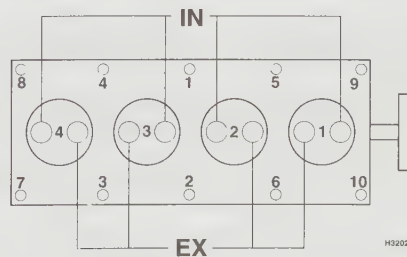
Dispatch / Jumpy 1.9 TD 1995 to 1999

*Bolt length below head: ≤150.5 mm

*0.66 to 0.76 bar @ 2000 rpm



1769 cm³ / 1905 cm³



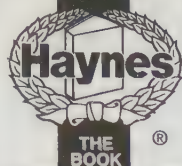
1868 cm³

- Not applicable, or information not available



CITROEN

	Dispatch / Jumpy 1.9 TD 1997 to 2000	Dispatch / Jumpy 1.9 D 1999 to 2000	Berlingo 1.8D 1996 to 1999	Berlingo 1.8D 1998 to 2000
Engine				
Engine type/code	XUD9BTF/L3 DHX Turbo 66kW	DW8 WJZ EGR SOHC 51kW	XUD7/L3 A9A SOHC 44kW	DW8 WJZ/C SOHC EGR 51kW
Capacity (cm ³) / cylinders	1905 / 4	1868 / 4	1769 / 4	1868 / 4
Compression ratio / pressure	21.5 / _	23.0 /	23.0 /	23.0 /
Torque outputNm	196	125	110	125
Oil pressureidle [running] bar	[4.1 @ 2000]	1.8 [3.7]	2.5	1.8 [3.7 @ 2000]
Oil temperature°C	80	90	80	80
Valve clearances - inlet (mm)	0.15 ± 0.05	0.15 ± 0.05	0.15 ± 0.08	0.15 ± 0.05
- exhaust (mm)	0.30 ± 0.05	0.30 ± 0.05	0.30 ± 0.08	0.30 ± 0.05
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	83	89 to 95	83	83
Radiator cap pressurebar	1.1	1.4	1.4	1.4
Fuel system				
Idle speedrpm	800 ± 50	800 ± 25	800 ± 50	800 ± 25 A/C: 875 ± 25
Maximum (no load) speedrpm	5100 ± 80	5350 ± 225	5150 ± 125	5350 ± 125
Smoke test/opacityM ⁻¹ %	2.5	3.0	1.56	2.5
Static timing method	Peg	Refer to wsm	-	Plunger travel
Timing dimension.....mm	0.57	-	Dimension on pump	0.58 ± 0.04
Crankshaft positionmm [°]	[0] TDC	-	-	TDC
Turbo type / ref / pressurebar	KKK K14 to Garrett T2	-	-	-
Injection pump make	Bosch	Bosch	Lucas	Bosch
Injection pump part no.....	R601	VE4 / 537	DPC 8443B930A	VE4 / 537
Injector Make / type	Bosch	-	CAV	-
Injector part no.....	DN0SD 299	-	LCR6730 75D	KCA 20S106
Injection type.....	Indirect	Bosch VE	Indirect DPC	Indirect
Injection opening pressure, New [used]...bar	175	120 ²	140	120 ²
Glow plugs				
Maker	Bosch	Beru/Champion	Bosch	Beru/Champion
Type	0 250 201 033	0100226371 / CH185	0 502 010 33	0100226371 / CH185
Nominal ratingV/A	11 / 9	-	11 / 12	11
Brakes				
minimum friction material thickness				
Front.....mm	8.5 with backing	8.5 with backing	1.0	1.5
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/70x14	195/70x14	165/70x14	165/70x14: 175/65x14
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	2.5 / 2.5	2.5 / 2.5	2.5 / 3.7	2.5 / 3.2
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 to 3.0	1.0 to 3.0	-1.0 ± 1.0 PAS: 3.5 ± 1.0	-1.0 ± 1.0 PAS: 3.5 ± 1.0
Camber	0 ± 30'	0° ± 30'	0° ± 1°	0° ± 1°
Castor	1° ± 30' PAS: 3°30' ± 30'	1° ± 30' PAS: 3°30' ± 30'	30' ± 40' PAS: 2° ± 40'	30' ± 40' PAS: 2° ± 40'
King pin inclination.....	11°28' ± 40'	11°28' ± 40'	10°8' ± 1°	10°50' ± 1°
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 to 3.0	1.0 to 3.0	-2.5 ± 1.0	-2.5 ± 1.0
Camber	-1° ± 30'	-1° ± 30'	1°15' ± 30'	-1°15' ± 1°



CITROEN

	Dispatch / Jumpy 1.9 TD 1997 to 2000	Dispatch / Jumpy 1.9 D 1999 to 2000	Berlingo 1.8D 1996 to 1999	Berlingo 1.8D 1998 to 2000
Torque wrench settings				
Cylinder head - stage 1Nm	20 ¹	20 ¹	20 ¹	20 ³
- stage 2Nm	60	60	60	60
- stage 3Nm	+ 220°	+ 180°	+ 180°	+ 180°
- stage 4Nm	-	-	-	-
- stage 5Nm	-	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	15 + 60°	70	70	70
Crankshaft pulley boltNm	40 + 50°	40 + 60°	40 + 60°	40 + 60°
Camshaft pulley boltNm	35	43	43	25 Hub: 43
Flywheel [driveplate] bolt.....Nm	50	48 N	75	48 N
Front hubsNm	100 + 60° oiled	100 + 60° oiled	320	320
Rear hubsNm	100 + 60°	100 + 60°	275	275
Wheel nuts / boltsNm	100	100	85	-
Glow plugsNm	22	25	22	25
Clutch pressure plate boltsNm	20	20	20	20
Injection pump sprocket.....Nm	50	23	50	23
Injectors.....Nm	90	90	90	90
Injection pump mounting boltsNm	20	20	-	20
Injector pipe unions.....Nm	20	25	25	25
Capacities				
Engine oil & filter.....litres	4.25	4.5	4.25	4.75
Gearbox.....litres	1.8	1.8	1.8	2.0
Automatic transmissionlitres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	9.0	9.0	8.0	10.5
Fuel tank.....litres	80	80	60	55

Notes

Dispatch / Jumpy 1.9 TD 1997 to 2000

¹Bolt length below head: ≤150.5 mm

Dispatch / Jumpy 1.9 D 1999 to 2000

¹Bolt length below head: ≤125.5 mm

³Lucas: 142 to 149

Berlingo 1.8D 1996 to 1999

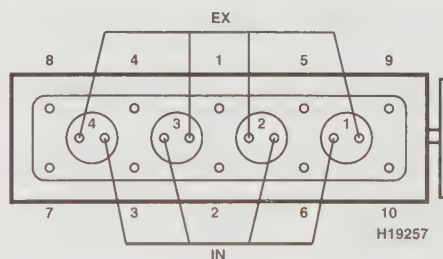
¹Bolt length below head: 125.5 mm Without guide boss: 121.5 mm

Berlingo 1.8D 1998 to 2000

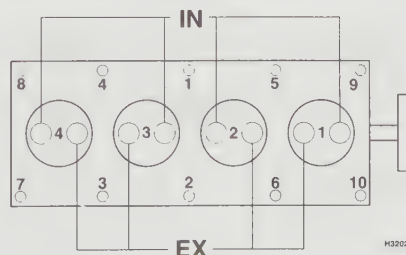
¹Lucary Varity DPC pump available as alternative

³Lucas: 142 to 149

³Bolt length below head: ≤125.5 mm

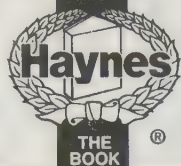


1769 cm³ / 1905 cm³



1868 cm³

- Not applicable, or information not available



CITROEN

	Berlingo 1.9D 1998 to 1999	C25D 1.9 1987 to 1991	C25D 1.9 1987 to 1991	C25D 2.5 1987 to 1991
Engine				
Engine type/code.....	XUD9A/L3 D9B SOHC 52kW	XUD9A D9B SOHC 51kW	XUD9A D9B SOHC 51kW	U25/661 OHV 54kW
Capacity (cm ³) / cylinders.....	1905 / 4	1905 / 4	1905 / 4	2500 / 4
Compression ration / pressurebar	23.0 /	23.0 /	23.0 /	22.25 /
Torque outputNm	120	0	0	0
Oil pressureidle [running] bar	[3.5 @ 4000]	[3.5]	[3.5]	[4.5 to 5.0]
Oil temperature°C	80	80	80	95
Valve clearances - inlet (mm)	0.15 ± 0.05	0.15 ± 0.08	0.15 ± 0.08	0.30
- exhaust (mm)	0.30 ± 0.05	0.30 ± 0.08	0.30 ± 0.08	0.20
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	83	88	88	83 to 86
Radiator cap pressurebar	1.4	1.0	1.0	0.9
Fuel system				
Idle speedrpm	800 ± 50	750 ± 50	750 ± 50	725 to 775
Maximum (no load) speedrpm	5150 ± 125	5150 ± 125	5100 ± 100	4375 to 4525
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	-	Plunger travel	Dial gauge	Refer to wsm
Timing dimension.....mm	Refer to pump	0.9	Dimension on pump	-
Crankshaft positionmm [°]	-	TDC peg	[TDC hole]	4.71 ± 0.05
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make	Lucas	Bosch	Roto Diesel	Roto Diesel
Injection pump part no.....	1018 445B010A	-	R8443B380A	R8443B111A
Injector Make / type.....	-	Bosch	Roto Diesel	Roto Diesel
Injector part no.....	Lucas 6887	DNOSD 287 or 287 +	RDNOSDC 6751 C	RDNOSDC 6577B
Injection type.....	Indirect	VER 272.1 or 272.2	DPC 057	Indirect DPC MA260
Injection opening pressure, New [used]...bar	140	130 +5 -0	125 ± 5	112 +5 -0
Glow plugs				
Maker	Bosch	Bosch	Bosch	Bosch
Type	0 250 201 039	91 521 918	0 250 201 019	0250 200 059
Nominal rating.....V/A	-	11 / 13	11 / 13	11 / 8.5
Brakes				
minimum friction material thickness				
Front.....mm	1.0	2.0	2.0	2.0
Rear.....mm	2.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	165/70x14	185x14; 185/75x14	185x14; 185/75x14	185x14; 185/75x14
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	2.3 / 3.7	Refer to manufacturer/handbook	Refer to manufacturer/handbook	Refer to manufacturer/handbook
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 ± 1.0 PAS: 3.5 ± 1.0	0.5 ± 1.0	0.5 ± 1.0	0.5 ± 1.0
Camber	0° ± 1°	1°50' to 2°50'	1°50' to 2°50'	1°50' to 2°50'
Castor	30' ± 40' PAS: 2° ± 40'	30' ± 30' 91 ▶: 45' ± 30'	30' ± 30' 91 ▶: 45' ± 30'	0° to 1°
King pin inclination.....	10° 08' ± 1°	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.5 ± 1.0	0 ± 1.0	0 ± 1.0	0 ± 1.0
Camber	1°15' ± 30'	-	-	-

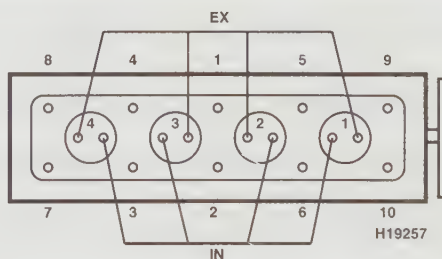


CITROEN

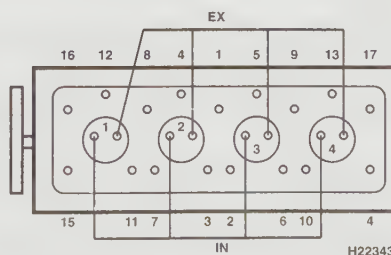
	Berlingo 1.9D 1998 to 1999	C25D 1.9 1987 to 1991	C25D 1.9 1987 to 1991	C25D 2.5 1987 to 1991
Torque wrench settings				
Cylinder head - stage 1Nm	20'	30 N	30 N	40
- stage 2Nm	60	70	70	+ 100°
- stage 3Nm	+ 180°	+ 120°	+ 120°	+ 100°
- stage 4Nm	-	-	-	Warm up, allow to cool
- stage 5Nm	-	-	-	+ 45°
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	50 N	50 N	50	90 N
Main bearings.....Nm	70	70	70	95
Crankshaft pulley boltNm	40 + 60°	150 LkC	150 LkC	-
Camshaft pulley boltNm	35	35	35	32
Flywheel [driveplate] bolt.....Nm	65	50 LkC	50 LkC	90 LkC
Front hubsNm	320	500 LkC	500 LkC	500 LkC
Rear hubs.....Nm	275	170	170	105 6.86►: 170
Wheel nuts / boltsNm	85	180	180	180
Glow plugsNm	22	22	22	28
Clutch pressure plate boltsNm	20	22	22	35
Injection pump sprocket.....Nm	50	-	50	-
Injectors.....Nm	90	90	90	25
Injection pump mounting boltsNm	-	-	-	-
Injector pipe unions.....Nm	25	20	20	9
Capacities				
Engine oil & filter.....litres	4.25	5.0	5.0	4.9
Gearbox.....litres	1.8	1.25	1.25	1.25
Automatic transmissionlitres	-	-	-	-
Final drivelitres	WT	WT	WT	WT
Cooling system.....litres	8.0	6.5	6.5	10.6
Fuel tank.....litres	60	70	70	70

Notes

Berlingo 1.9D 1998 to 1999
 'Bolt length below head: ≤121.5 mm

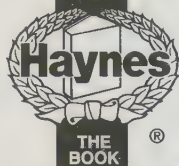


1905 cm³



2500 cm³

- Not applicable, or information not available



CITROEN

	Jumper/Relay 1.9 D 1996 to 1999	Jumper/Relay 1.9 TD 1996 to 1999	Jumper/Relay 1.9 TD 1995 to 1996	Jumper/Relay 1.9 TD 1999 to 2000
Engine				
Engine type/code.....	XUD9AU/W2 D9B SOHC 51kW	XUD9UTF/W2 D8C Turbo 67kW	XUD9UTF/X3 DHX Turbo 66kW	XUD9TFU/W3 DHX Turbo 66kW
Capacity (cm ³) / cylinders.....	1905 / 4	1905 / 4	1905 / 4	1905 / 4
Compression ratio / pressure.....bar	23.0 / _	21.8 / _	21.8 / _	21.8 / _
Torque outputNm	120	196	196	196
Oil pressureIdle [running] bar	2.2 [4.6]	2.4 [4.8]	2.4 [4.8]	2.4 [4.8]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0.15 ± 0.05	0.15 ± 0.08	0.15 ± 0.08	0.15 ± 0.08
- exhaust (mm).....	0.30 ± 0.05	0.30 ± 0.08	0.30 ± 0.08	0.30 ± 0.08
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	83	83	83	83
Radiator cap pressure.....bar	1.0	1.0	1.0	1.0
Fuel system				
Idle speedrpm	750 to 800	800 ± 50 A/C: 850 ± 50	800 ± 50 A/C: 850 ± 50	800 ± 50 A/C: 850 ± 50
Maximum (no load) speedrpm	5150 ± 125	5050 ± 125	5050 ± 125	5050 ± 125
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	1.07 ± 0.01	0.66 ± 0.01	0.66 ± 0.01	0.66 ± 0.01
Crankshaft positionmm [°]	TDC [0]	TDC [0]	TDC [0]	TDC [0]
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VER 425 / XUD201	VER 445 / XUD203	XUD 212	VER 445 / XUD203
Injector Make / type.....	Bosch	Bosch	Bosch	Bosch
Injector part no.....	299A	299	299	299
Injection type.....	Indirect VER	Indirect VER	Indirect	Indirect VER
Injection opening pressure, New [used]...bar	130	175.0	175.0	175
Glow plugs				
Maker.....	Beru/Bosch	Beru/Bosch	Beru/Bosch	Beru/Bosch
Type.....	0100 221 133 / 0250 201 019	0100 226 186 / 0250 201 033	0100 226 186 / 0250 201 033	0100 226 186 / 0250 201 033
Nominal rating.....V/A	11 /	11 /	11 /	11 /
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/70x15	195/70x15: 205/70x15	195/70x15: 205/70x15	195/70x15: 205/70x15
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Van.....bar	3.0 / 3.0	3.0 / 3.0	3.0 / 3.0	3.0 / 3.0
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 1.0	0 ± 1.0	0 ± 1.0	0 ± 1.0
Camber.....	0° ± 30'	0° ± 30'	0° ± 30'	0° ± 30'
Castor.....	1° ± 30'	1° ± 30'	1° ± 30'	1° ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 1.0	0 ± 1.0	0 ± 1.0	0 ± 1.0
Camber.....	0° ± 10'	0° ± 10'	0° ± 10'	0° ± 10'



CITROEN

	Jumper/Relay 1.9 D 1996 to 1999	Jumper/Relay 1.9 TD 1996 to 1999	Jumper/Relay 1.9 TD 1995 to 1996	Jumper/Relay 1.9 TD 1999 to 2000
Torque wrench settings				
Cylinder head - stage 1.....Nm	20 ¹	20 ¹	20 ¹	20 ¹
- stage 2.....Nm	60	60	60	60
- stage 3.....Nm	+ 180°	+ 220°	+ 220°	+ 220°
- stage 4.....Nm	-	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	40, slacken, 20 + 70° N	40, slacken, 20 + 70° N	40, slacken, 20 + 70° N	40, slacken, 20 + 70° N
Main bearings.....Nm	70	70	70	70
Crankshaft pulley bolt.....Nm	40 + 51°	40 + 51°	40 + 51°	40 + 51°
Camshaft pulley bolt.....Nm	45	45	45	45
Flywheel [driveplate] bolt.....Nm	50 N LkC	50 N LkC	50 N LkC	50 N LkC
Front hubs.....Nm	450 18Q model: 500	450 18Q model: 500	450 18Q model: 500	450 18Q model: 500
Rear hubs.....Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	160 18Q model: 180	160 18Q model: 180	160 18Q model: 180	160 18Q model: 180
Glow plugs.....Nm	18	18	18	18
Clutch pressure plate bolts.....Nm	20	20	20	20
Injection pump sprocket.....Nm	-	-	-	-
Injectors.....Nm	90	90	90	90
Injection pump mounting bolts.....Nm	-	-	-	-
Injector pipe unions.....Nm	-	-	-	-
Capacities				
Engine oil & filter.....litres	5.0	6.3	6.3	6.3
Gearbox.....litres	1.85	1.85	1.85	1.85
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	9.5	12.0	12.0	12.0
Fuel tank.....litres	80	-	80	80

Notes

Jumper/Relay 1.9 D 1996 to 1999

¹Bolt length below head: ≤121.5 mm Bolt with guide boss: ≤124.5 mm

Jumper/Relay 1.9 TD 1996 to 1999

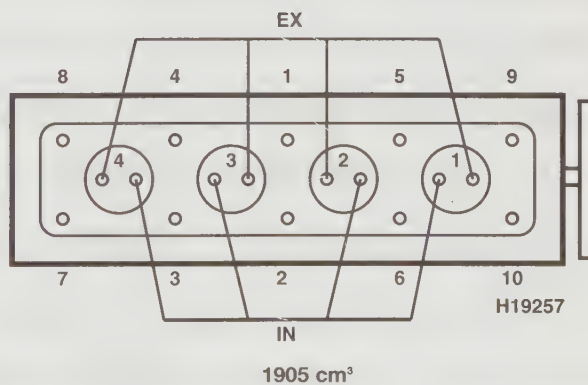
¹Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤150.5 mm

Jumper/Relay 1.9 TD 1995 to 1996

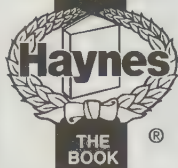
¹Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤150.5 mm

Jumper/Relay 1.9 TD 1999 to 2000

¹Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤150.5 mm



- Not applicable, or information not available



CITROEN

	Jumper/Relay 1.9 D 1999 to 2000	Jumper/Relay 2.5 D 1996 to 2000	Jumper/Relay 2.5D Turbo 1996 to 2000	Jumper/Relay 2.5 iDi Turbo 1995 to 1996
Engine				
Engine type/code.....	XUD9AU/W3 DJY 50kW	DJ5/W2 T9A SOHC 12V 63kW	DJ5T/W2 T8A Turbo 76kW	DJ5T/X3 THZ Turbo 12V 76kW
Capacity (cm ³) / cylinders.....	1905 / 4	2446 / 4	2446 / 4	2446 / 4
Compression ration / pressurebar	23.0 / _	23.0 / _	23.0 / _	21.0 / _
Torque outputNm	120	153	230	230
Oil pressureidle [running] bar	2.2 [4.6]	2.2 [4.6]	2.2 [4.6]	2.2 [4.6]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0.15 ± 0.08	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm).....	0.30 ± 0.08	0: Hyd.	0: Hyd.	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	83	83	83	83
Radiator cap pressurebar	1.00	1.0	1.0	1.0
Fuel system				
Idle speedrpm	800 ± 50 A/C: 850 ± 50	800 ± 50	800 ± 50	725 ± 25 A/C: 775 ± 25
Maximum (no load) speedrpm	5150 ± 125	5150 ± 125	5150 ± 125	4900 ± 125
Smoke test/opacityM ⁻¹ %	2.5	3.0	3.0	2.0
Static timing method.....	Plunger travel	Plunger travel	Refer to wsm	Refer to wsm
Timing dimension.....mm	1.07 ± 0.01	1.07 ± 0.01	-	-
Crankshaft positionmm [°]	TDC [0]	TDC [0]	-	-
Turbo type / ref / pressurebar	-	-	KKK K14	-
Injection pump make.....	Bosch	Bosch	Bosch	Lucas
Injection pump part no.....	VER 425/* XUD201	VER 4/9F 2175 R504	VER 425/* XUD201	DPC R8444B281B
Injector Make / type.....	Bosch	Bosch	Bosch	CAV
Injector part no.....	299A	DNOSD 312	299A	LDC003R
Injection type.....	Indirect VER	Indirect VER	Indirect VER	Direct DPC
Injection opening pressure, New [used]...bar	130.0	140 to 145	130.0	168 to 173
Glow plugs				
Maker.....	Beru/Bosch	Beru/Bosch	Beru/Bosch	Beru/Bosch
Type.....	0100 221 133 / 0250 201 019	0100 221 133 / 0250 201 019	0100 221 133 / 0250 201 019	0100 221 133 / 0250 201 019
Nominal ratingV/A	11 /	11 /	11 /	11 / 9
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/70x15: 205/70x15	195/70x15: 205/70x16	195/70x15: 205/70x16	195/70x15: 205/70x15
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Van.....bar	Refer to vehicle	3.0 / 3.0	3.0 / 3.0	Refer to vehicle
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 1.0	0 ± 1.0	0 ± 1.0	0 ± 1.0
Camber.....	0° ± 30'	0° ± 30'	0° ± 30'	0° ± 30'
Castor.....	1° ± 30'	1° ± 30'	1° ± 30'	1° ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 1.0	0 ± 1.0	0 ± 1.0	0 ± 1.0
Camber.....	0° ± 10'	0° ± 1°	0° ± 10'	0° ± 10'



CITROEN

	Jumper/Relay 1.9 D 1999 to 2000	Jumper/Relay 2.5 D 1996 to 2000	Jumper/Relay 2.5D Turbo 1996 to 2000	Jumper/Relay 2.5 iDi Turbo 1995 to 1996
Torque wrench settings				
Cylinder head - stage 1Nm	20 ¹	M10: 35 M12: 50 ¹	M10: 3.5 M12: 50 ¹	M10: 35 M12: 50 ¹
- stage 2Nm	60	+ 120°	+ 150°	+ 150°
- stage 3Nm	+ 180°	-	-	-
- stage 4Nm	-	-	-	-
- stage 5Nm	-	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	40, slacken, 20 + 70° N	50 N	50 N	50 N
Main bearings.....Nm	70	70	70	70
Crankshaft pulley boltNm	40 + 51°	40 + 51°	40 + 51°	40 + 51°
Camshaft pulley boltNm	45	45	45	45
Flywheel [driveplate] bolt.....Nm	50 N LkC	50 N LkC	50 N LkC	50 N LkC
Front hubsNm	450 18Q model: 500	450 18Q model: 500	450 18Q model: 500	450 18Q model: 500
Rear hubsNm	WSM	WSM	WSM	WSM
Wheel nuts / boltsNm	160 18Q model: 180	160 18Q model: 180	160 18Q model: 180	160 18Q model: 180
Glow plugsNm	18	18	18	18
Clutch pressure plate boltsNm	20	20	20	20
Injection pump sprocket.....Nm	-	25	25	25
Injectors.....Nm	90	55	90	55
Injection pump mounting boltsNm	-	-	-	25
Injector pipe unions.....Nm	-	20	25	25
Capacities				
Engine oil & filter.....litres	6.3	9.0	8.0	6.3
Gearbox.....litres	1.85	1.85	1.85	1.85
Automatic transmissionlitres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	12.0	12.0	12.0	12.0
Fuel tank.....litres	-	80	80	80

Notes

Jumper/Relay 1.9 D 1999 to 2000

¹Bolt length below head: ≤121.5 mm Bolt with guide boss: ≤125.5 mm

Jumper/Relay 2.5 D 1996 to 2000

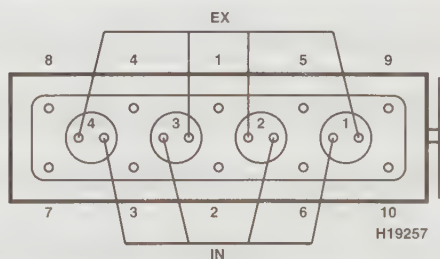
¹ Max overall bolt length: M10 162.5 mm
M12 153.5 mm

Jumper/Relay 2.5D Turbo 1996 to 2000

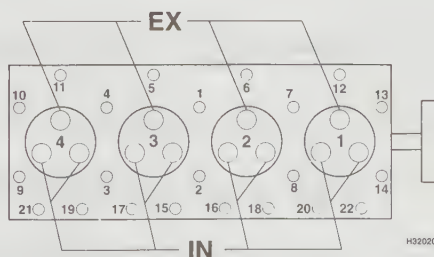
¹ Max overall bolt length: M10 189.3 mm
M12 178.3 mm

Jumper/Relay 2.5 iDi Turbo 1995 to 1996

¹Max overall bolt length: M10 189.3 mm
M12 178.3 mm



1905 cm³



2446 cm³

- Not applicable, or information not available



CITROEN

	Jumper/Relay 2.5 TDi 1996 to 1997			
Engine				
Engine type/code	DJ5TED/W2 THX Turbo 12V 79kW			
Capacity (cm ³) / cylinders	2446 / 4			
Compression ration / pressurebar	20.0 / _			
Torque outputNm	230			
Oil pressureidle [running] bar	2.2 [4.6]			
Oil temperature°C	80			
Valve clearances - inlet (mm)	0: Hyd.			
- exhaust (mm)	0: Hyd.			
Injection order	1-3-4-2			
No. 1 cylinder position	FE			
Cooling system				
Thermostat opening temperature°C	83			
Radiator cap pressurebar	1.0			
Fuel system				
Idle speedrpm	850 ± 50 A/C: 900 ± 50			
Maximum (no load) speedrpm	4900 ± 150			
Smoke test/opacityM ⁻¹ %	2.0			
Static timing method.....	Refer to wsm			
Timing dimension.....mm	_			
Crankshaft positionmm [°]	TDC			
Turbo type / ref / pressurebar	KKK K14			
Injection pump make	Bosch			
Injection pump part no.....	VER683			
Injector Make / type	Bosch			
Injector part no.....	140PV3375955			
Injection type.....	Direct VER			
Injection opening pressure, New [used]...bar	200			
Glow plugs				
Maker	Beru			
Type	0100 221 133			
Nominal rating.....V/A	_			
Brakes				
minimum friction material thickness				
Front.....mm	2.0			
Rear.....mm	1.0			
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/70x15: 205/70x15			
Pressure - front / rear - Saloon / Hatch...bar	_			
- Estate / Vanbar	Refer to vehicle			
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 1.0			
Camber	0° ± 30'			
Castor	1° ± 30'			
King pin inclination.....	_			
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 1.0			
Camber	0° ± 10'			



CITROEN

Jumper/Relay 2.5 TDi
1996 to 1997

Torque wrench settings

Cylinder head - stage 1	Nm	M10: 35 M12: 50 ¹		
- stage 2	Nm	+ 150°		
- stage 3	Nm	-		
- stage 4	Nm	-		
- stage 5	Nm	-		
- stage 6	Nm	-		
Big-end bearings	Nm	50 N		
Main bearings	Nm	70		
Crankshaft pulley bolt	Nm	40 + 51°		
Camshaft pulley bolt	Nm	45		
Flywheel [driveplate] bolt	Nm	50 N LkC		
Front hubs	Nm	450 18Q model: 500		
Rear hubs	Nm	WSM		
Wheel nuts / bolts	Nm	160 18Q model: 180		
Glow plugs	Nm	18		
Clutch pressure plate bolts	Nm	20		
Injection pump sprocket	Nm	25		
Injectors	Nm	55		
Injection pump mounting bolts	Nm	-		
Injector pipe unions	Nm	25		

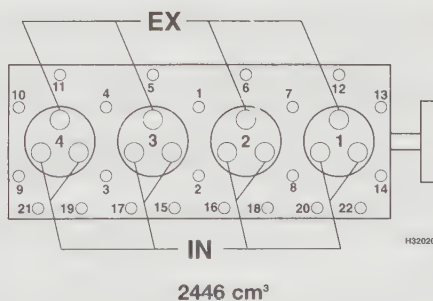
Capacities

Engine oil & filter	litres	8.0		
Gearbox	litres	1.85		
Automatic transmission	litres	-		
Final drive	litres	WT		
Cooling system	litres	12.0		
Fuel tank	litres	80		

Notes

Jumper/Relay 2.5 TDi 1996 to 1997

¹ Max overall bolt length: M10 189.3 mm
M12 178.3 mm



- Not applicable, or information not available



DACIA

	Duster 1989 to 1991			
Engine				
Engine type/code	F8M			
Capacity (cm ³) / cylinders	1596 / 4			
Compression ration / pressurebar	22.5 / ≥20.0			
Torque outputNm	0			
Oil pressureidle (running) bar	2.0 [3.5]			
Oil temperature°C	80			
Valve clearances - inlet (mm)	0.20			
- exhaust (mm)	0.40			
Injection order	1-3-4-2			
No. 1 cylinder position	FE			
Cooling system				
Thermostat opening temperature°C	83			
Radiator cap pressurebar	0.9 ± 0.1			
Fuel system				
Idle speedrpm	850 ± 25			
Maximum (no load) speedrpm	5300			
Smoke test/opacityM-1 %	2.5			
Static timing method.....	Dial gauge			
Timing dimension.....mm	1.6 ± 0.02			
Crankshaft positionmm [°]	[0] TDC			
Turbo type / ref / pressurebar	-			
Injection pump make	Roto Diesel			
Injection pump part no.....	-			
Injector Make / type	Roto Diesel			
Injector part no.....	RDNOSDC 6843C			
Injection type.....	DPCR 8443 A370A			
Injection opening pressure, New [used]...bar	118 +7 -5			
Glow plugs				
Maker	Champion			
Type	CH88, CH137			
Nominal ratingV/A	-			
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing			
Rear.....mm	-			
Tyres - Saloon / Hatch Size				
- Estate / Van.....	Size			
Pressure - front / rear - Saloon / Hatch ...bar	-			
- Estate / Vanbar	1.9 / 2.1			
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.5 to 5.0			
Camber	1°30' ± 30'			
Castor	2°30' ± 30'			
King pin inclination.....	9°30' ± 30'			
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-			
Camber	-			



DACIA

Duster
1989 to 1991

Torque wrench settings

Cylinder head - stage 1	Nm	30
- stage 2	Nm	70
- stage 3	Nm	Wait 3 mins
- stage 4	Nm	Slacken
- stage 5	Nm	20
- stage 6	Nm	+ 123°
Big-end bearings	Nm	45 to 50 N
Main bearings	Nm	60 to 65
Crankshaft pulley bolt	Nm	90 to 100
Camshaft pulley bolt	Nm	50
Flywheel [driveplate] bolt	Nm	50 to 55
Front hubs	Nm	-
Rear hubs	Nm	-
Wheel nuts / bolts	Nm	80
Glow plugs	Nm	15 to 30
Clutch pressure plate bolts	Nm	25
Injection pump sprocket	Nm	50
Injectors	Nm	65 to 75
Injection pump mounting bolts	Nm	-
Injector pipe unions	Nm	25

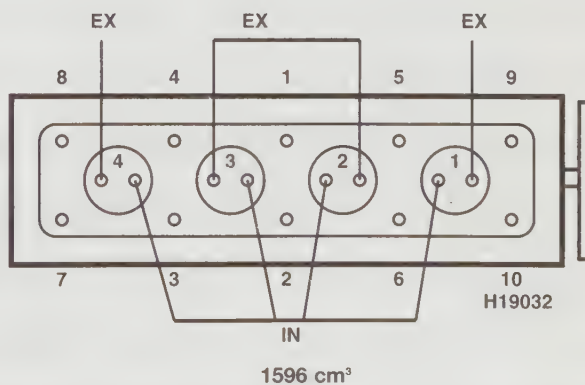
Capacities

Engine oil & filter	litres	5.5
Gearbox	litres	1.4 ¹
Automatic transmission	litres	-
Final drive	litres	Front: 0.8 Rear: 1.4
Cooling system	litres	7.0
Fuel tank	litres	46

Notes

Duster 1989 to 1991

¹Transfer box: 0.8



- Not applicable, or information not available



DAEWOO

	Korando 2.9 TDi 1999 to 2000	Musso 2.9 TDi 1999 to 2000		
Engine				
Engine type/code.....	OM662LA Turbo SOHC 87kW	OM662LA Turbo SOHC 87kW		
Capacity (cm ³) / cylinders.....	2874 / 5	2874 / 5		
Compression ratio / pressurebar	22.1 / ≥18.0	22.1 / ≥18.0		
Torque outputNm	250	250		
Oil pressureidle [running] bar	—	—		
Oil temperature°C	—	—		
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.		
- exhaust (mm)	0: Hyd.	0: Hyd.		
Injection order	1-2-4-5-3	1-2-4-5-3		
No. 1 cylinder position	F	F		
Cooling system				
Thermostat opening temperature°C	80	80		
Radiator cap pressurebar	—	—		
Fuel system				
Idle speedrpm	770 ± 50	770 ± 50		
Maximum (no load) speedrpm	—	—		
Smoke test/opacityM ⁻¹ %	2.0	2.0		
Static timing method.....	Refer to wsm	Refer to wsm		
Timing dimension.....mm	—	—		
Crankshaft positionmm [°]	—	—		
Turbo type / ref / pressurebar	—	—		
Injection pump make	Bosch	Bosch		
Injection pump part no.....	PES 4 M55 C320 RS 191	PES 4 M55 C320 RS 191		
Injector Make / type	—	—		
Injector part no.....	—	—		
Injection type.....	Indirect, intercooled	Indirect, intercooled		
Injection opening pressure, New [used]...bar	115 to 125 [100]	115 to 125 [100]		
Glow plugs				
Maker	—	—		
Type	—	—		
Nominal ratingV/A	—	—		
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0		
Rear.....mm	1.5	1.5		
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	235/75x15	235/75x15		
Pressure - front / rear - Saloon / Hatch...bar	—	—		
- Estate / Vanbar	2.1 / 2.1	2.1 / 2.1		
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.4	0.4		
Camber	0° ± 30'	0° ± 30'		
Castor	2° 30' ± 30'	2° 30' ± 30'		
King pin inclination.....	12° 30'	12° 30'		
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	—	—		
Camber	—	—		



DAEWOO

	Korando 2.9 TDi 1999 to 2000	Musso 2.9 TDi 1999 to 2000		
Torque wrench settings				
Cylinder head - stage 1Nm	15 N	15 N		
- stage 2Nm	35	35		
- stage 3Nm	+ 90°	+ 90°		
- stage 4Nm	+ 90°	+ 90°		
- stage 5Nm	—	—		
- stage 6Nm	—	—		
Big-end bearingsNm	40 + 90° N	40 + 90° N		
Main bearingsNm	55 + 90° N	55 + 90° N		
Crankshaft pulley boltNm	—	—		
Camshaft pulley boltNm	—	—		
Flywheel [driveplate] boltNm	45 + 90° N	45 + 90° N		
Front hubsNm	WSM	WSM		
Rear hubsNm	WSM	WSM		
Wheel nuts / boltsNm	90°	90°		
Glow plugsNm	—	—		
Clutch pressure plate boltsNm	35	35		
Injection pump sprocketNm	—	—		
InjectorsNm	—	—		
Injection pump mounting boltsNm	—	—		
Injector pipe unionsNm	—	—		
Capacities				
Engine oil & filterlitres	8.0	8.0		
Gearboxlitres	1.8	1.8		
Automatic transmissionlitres	—	—		
Final drivelitres	Rear: 1.9 Front: 1.4 ²	Rear: 1.9 Front: 1.4 ²		
Cooling systemlitres	10.0	10.0		
Fuel tanklitres	80	80		

Notes

Korando 2.9 TDi 1999 to 2000

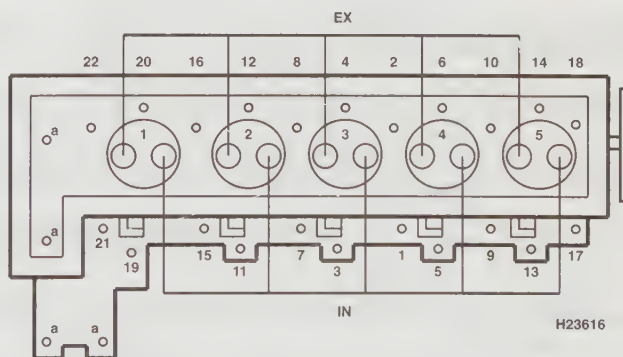
¹Alloy: 125

²Transfer: 1.4

Musso 2.9 TDi 1999 to 2000

¹Alloy: 125

²Transfer: 1.4

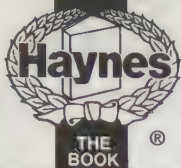


2874 cm³



DAIHATSU

	Charade 1.0 Turbo 1990 to 1993	F70 & Fourtrak 1984 to 1993	F70 & Fourtrak Turbo 1984 to 1993	F70 & Fourtrak 1989 to 1998
Engine				
Engine type/code	CL61 SOHC Turbo 35kW	DL50 OHV 54kW	DL51 OHV Turbo 67kW	DL42 OHV 54kW
Capacity (cm ³) / cylinders	993 / 3	2765 / 4	2765 / 4	2765 / 4
Compression ratio / pressure	21.5 / ≥18.0	21.5 / ≥21.6	21.5 / ≥21.6	21.2 / ≥21.6
Torque outputNm	0	0	0	0
Oil pressureidle [running] bar	[3.1 to 4.1]	[4.4 to 5.4]	[4.4 to 5.4]	[4.4 to 5.4]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.25 ± 0.05	0.25 H	0.25 H	0.25 H
- exhaust (mm)	0.30 ± 0.05	0.30 H	0.35 H	0.25 H
Injection order	1-2-3	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TCE	TCE	TCE
Cooling system				
Thermostat opening temperature°C	88 ± 1.5	80 to 84	80 to 84	80 to 84
Radiator cap pressurebar	0.9	0.9	0.9	0.9
Fuel system				
Idle speedrpm	850 ± 50	650 ± 50	650 ± 50	650 ± 50
Maximum (no load) speedrpm	5600 +150 -100	4100 to 4175	4600	4500
Smoke test/opacityM ⁻¹ %	2.5	3.0	3.0	3.0
Static timing method	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	0.89 ± 0.03	0.97 to 1.03	0.97 to 1.03	1.06 ± 0.03
Crankshaft positionmm [°]	[0] TDC	[0] TDC	TDC	[1] BTDC
Turbo type / ref / pressurebar	0.5 to 0.7 bar	-	0.55 to 0.85 @ 3400 rpm	-
Injection pump make	Bosch	Nippon Denso	Bosch	Bosch
Injection pump part no.....	VE	VE	VE4	VE
Injector Make / type	Nippon Denso	Nippon Denso	Nippon Denso	Single hole
Injector part no.....	ND-DN12SD12A	DN12S 012A	093400 - 0510	-
Injection type.....	Indirect VE	Indirect VE	Indirect VE	Indirect VE
Injection opening pressure, New [used]...bar	132 to 142	108 ± 5	105 to 115	108 ± 5
Glow plugs				
Maker	Bosch	Bosch	Bosch	Bosch
Type	0250 2020 074	0250 202 051	0250 202 051	0250 202 051
Nominal rating.....V/A	11.0 / 6.4	8.5 / 9	-	8.5 / 10
Brakes				
minimum friction material thickness				
Front.....mm	1.0	1.0	1.0	1.0
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	165/70x13	-	-	-
Pressure - front / rear - Saloon / Hatch...bar	-	215x15	215x15	215x15
- Estate / Vanbar	2.0 / 2.0	-	-	-
	-	1.2 / 1.7	1.2 / 1.7	1.2 / 1.7
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0	0 ± 3.0	0 ± 3.0	0 ± 3.0
Camber	20' ± 1°	1° ± 1°	1° ± 1°	1° ± 1°
Castor	2°55' ± 1°	1°30' ± 1°	1°30' ± 1°	1°30' ± 1°
King pin inclination.....	12° ± 1°	9°30' ± 1°	9°30' ± 1°	9°30' ± 1°
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	5.0	-	-	-
Camber	40'	-	-	-



DAIHATSU

	Charade 1.0 Turbo 1990 to 1993	F70 & Fourtrak 1984 to 1993	F70 & Fourtrak Turbo 1984 to 1993	F70 & Fourtrak 1989 to 1998
Torque wrench settings				
Cylinder head - stage 1.....Nm	85 to 95	108 to 127	108 to 127	108 to 127
- stage 2.....Nm	-	-	-	-
- stage 3.....Nm	-	-	-	-
- stage 4.....Nm	-	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	42 to 52 N	64 to 73 N	64 to 73 N	64 to 73 N
Main bearings.....Nm	54 to 66	96 to 110	96 to 110	96 to 110
Crankshaft pulley bolt.....Nm	55	240	240	240
Camshaft pulley bolt.....Nm	45	50	50	50
Flywheel [driveplate] bolt.....Nm	50 to 60	113 to 137	113 to 137	113 to 137
Front hubs.....Nm	176 to 216	WSM	WSM	WSM
Rear hubs.....Nm	58 to 98	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	88 to 118	88 to 118	88 to 118	88 to 118
Glow plugs.....Nm	14	18	18	18
Clutch pressure plate bolts.....Nm	7 to 10	15 to 24	15 to 24	15 to 24
Injection pump sprocket.....Nm	65	-	90	90
Injectors.....Nm	50 to 70	80	60 to 80	60 to 80
Injection pump mounting bolts.....Nm	18	30	30	-
Injector pipe unions.....Nm	25	27	30	30
Capacities				
Engine oil & filter.....litres	3.5	6.0	6.0	6.4
Gearbox.....litres	2.1	2.8 ¹	2.8 ¹	2.8 ¹
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	1.5	1.5	1.5
Cooling system.....litres	4.4	11.0	11.0	11.0
Fuel tank.....litres	38	60	60	60

Notes

F70 & Fourtrak 1984 to 1993

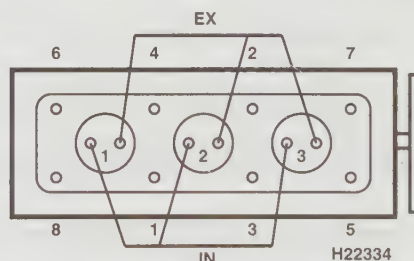
¹Transfer box: 1.3

F70 & Fourtrak Turbo 1984 to 1993

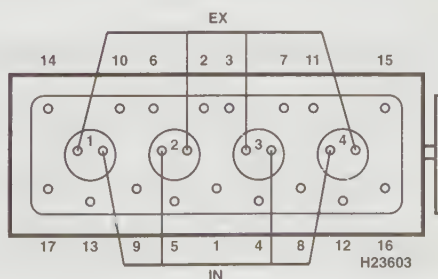
¹Transfer box: 1.3

F70 & Fourtrak 1989 to 1998

¹Transfer box: 1.3

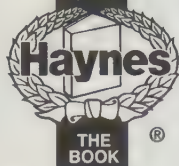


993 cm³



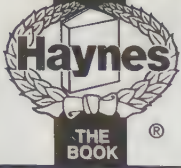
2765 cm³

- Not applicable, or information not available



DAIHATSU

	Fourtrack Independent 1993 to 2000	Hijet 1.2 D 1996 to 2000		
Engine				
Engine type/code	DL52 OHV Turbo 73kW	SOHC 26kW		
Capacity (cm ³) / cylinders	2765 / 4	1221 / 4		
Compression ratio / pressurebar	21.2 / ≥21.6	23.0 /		
Torque outputNm	245	71		
Oil pressureidle [running] bar	1.5 [3.0]	[3.0 @ 2200]		
Oil temperature°C	80	80		
Valve clearances - inlet (mm)	0.25 H	0.20		
- exhaust (mm)	0.35 H	0.20		
Injection order	1-3-4-2	1-3-4-2		
No. 1 cylinder position	TBE	TBE		
Cooling system				
Thermostat opening temperature°C	80 to 84	88		
Radiator cap pressurebar	0.9	0.9		
Fuel system				
Idle speedrpm	650 ± 50	900 ± 50		
Maximum (no load) speedrpm	4500	4900		
Smoke test/opacityM ⁻¹ %	3.0	3.0		
Static timing method	Plunger travel	-		
Timing dimension.....mm	1.06 ± 0.03	-		
Crankshaft positionmm [°]	[1] BTDC	-		
Turbo type / ref / pressurebar	0.5 to 0.8 bar @ 3500	-		
Injection pump make	Bosch	-		
Injection pump part no.....	VE	-		
Injector Make / type	Single hole	-		
Injector part no.....	-	-		
Injection type.....	Indirect VE	Indirect		
Injection opening pressure, New [used]...bar	108 ± 5 [127]	140 to 155		
Glow plugs				
Maker	Bosch	-		
Type	0250 202 051	-		
Nominal ratingV/A	7 / 8.5	-		
Brakes				
minimum friction material thickness				
Front.....mm	1.0	1.0		
Rear.....mm	1.0	1.0		
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	215x15	155x12		
Pressure - front / rear - Saloon / Hatch...bar	-	-		
- Estate / Vanbar	2.0 / 1.8	Refer to vehicle		
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 ± 1.0	1.5 ± 1.0		
Camber	0°30' ± 30'	1°40'		
Castor	2°20' ± 45'	3° 02' ± 1°		
King pin inclination.....	10°	11°25' ± 1°		
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-		
Camber	-	-		



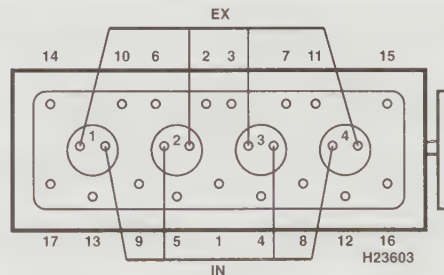
DAIHATSU

	Fourtrack Independant 1993 to 2000	Hijet 1.2 D 1996 to 2000		
Torque wrench settings				
Cylinder head - stage 1.....Nm	108 to 127	50		
- stage 2.....Nm	-	+ 90°		
- stage 3.....Nm	-	+ 120°		
- stage 4.....Nm	-	-		
- stage 5.....Nm	-	-		
- stage 6.....Nm	-	-		
Big-end bearings.....Nm	64 to 73 N	40 N		
Main bearings.....Nm	96 to 110	60		
Crankshaft pulley bolt.....Nm	240	360		
Camshaft pulley bolt.....Nm	50	-		
Flywheel [driveplate] bolt.....Nm	113 to 137	80		
Front hubs.....Nm	WSM	177 to 216		
Rear hubs.....Nm	WSM	39 to 53		
Wheel nuts / bolts.....Nm	88 to 118	55		
Glow plugs.....Nm	18	20		
Clutch pressure plate bolts.....Nm	15 to 24	10		
Injection pump sprocket.....Nm	90	-		
Injectors.....Nm	60 to 80	20		
Injection pump mounting bolts.....Nm	-	-		
Injector pipe unions.....Nm	30	-		
Capacities				
Engine oil & filter.....litres	6.4	4.15		
Gearbox.....litres	6.4 ¹	0.7		
Automatic transmission.....litres	-	-		
Final drive.....litres	1.5	1.2		
Cooling system.....litres	10.6	5.5		
Fuel tank.....litres	60	35		

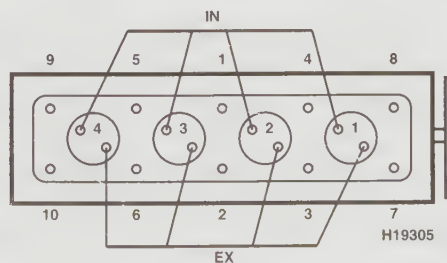
Notes

Fourtrack Independant 1993 to 2000

¹Transfer box: 1.3



2765 cm³



1221 cm³

- Not applicable, or information not available



FIAT

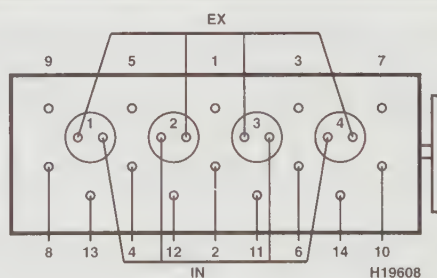
	Panda 1300 & Van 1987 to 1991	Uno 1.3 1990 to 1991	Uno 1.4 Turbo 1990 to 1994	Uno 1.7 1990 to 1995
Engine				
Engine type/code	156 A5.000 OHC 27kW	146 B1.000 OHC 33 kW	146 B3.000 OHC Turbo 52kW	146 B2.000 OHC 42kW
Capacity (cm ³) / cylinders	1301 / 4	1301 / 4	1367 / 4	1697 / 4
Compression ratio / pressure	20.0 / _	20.0 / _	20.0 ± 0.5 / _	20.5 ± 0.5 / _
Torque output	0	0	0	0
Oil pressureIdle [running] bar	[2.9 to 3.9]	[3.4 to 4.9]	[3.4 to 4.9]	[3.4 to 4.9]
Oil temperature°C	100	100	100	100
Valve clearances - inlet (mm)	0.35	0.35	0.30 ± 0.05	0.30 ± 0.05
- exhaust (mm)	0.40	0.40	0.35 ± 0.05	0.35 ± 0.05
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	85 to 89	78 to 82	78 to 82	78 to 82
Radiator cap pressure	0.98	0.78	0.78	0.78
Fuel system				
Idle speedrpm	775 ± 25	780 ± 20	800 ± 20	760 ± 20
Maximum (no load) speedrpm	5560 ± 50	5560 ± 50	5460 ± 50	5150 ± 50
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	0.77 [4 ± 1 ATDC]	0.82 [3 ± 1 ATDC]	1.05 [1 ± 1 ATDC]	1.0 [0 ± 1 ATDC]
Crankshaft positionmm [°]	0 TDC	0 TDC	0 TDC	0 TDC
Turbo type / ref / pressure	-	-	-	-
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	-	-	VER 349	0 460 484 015
Injector Make / type	Bosch	Bosch	Bosch	Bosch
Injector part no.....	DM 12 SD 1750	DN 12 SD 296	DN 12 SD 290	DN 12 SD 290
Injection type.....	VE 4/8 F2000 R61-1	VE R 355	VE R 349	VE R 308
Injection opening pressure, New [used]...bar	125 to 133	125 to 133	150 to 158	125 to 133
Glow plugs				
Maker	Marelli/Champion	Marelli/Champion	Marelli/Champion	Marelli/Champion
Type	UX2A / CH68	UX2A / CH68	UX2A / CH68	UX2A / CH68
Nominal rating.....V/A	-	-	11 / 12	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.5	1.5	1.5
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	135x13	155/70x13	155/70x13	155/70x13
Pressure - front / rear - Saloon / Hatch...bar	2.0 / 2.0	1.9 / 1.9	2.0 / 1.9	2.0 / 1.9
- Estate / Vanbar	2.0 / 2.0	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-2.0 ± 2.0	1.0 ± 1.0	1.0 ± 1.0	1.0 ± 1.0
Camber	1° ± 30'	-30' ± 30'	-30' ± 30'	-30' ± 30'
Castor	2°30' ± 30'	2°10' ± 30'	2°10' ± 30'	2°10' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0	-	-	-
Camber	0	-	-	-



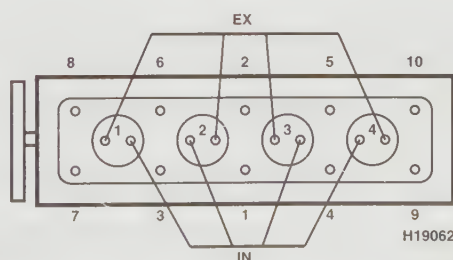
FIAT

	Panda 1300 & Van 1987 to 1991	Uno 1.3 1990 to 1991	Uno 1.4 Turbo 1990 to 1994	Uno 1.7 1990 to 1995
Torque wrench settings				
Cylinder head - stage 1Nm	30	30	50	50
- stage 2Nm	65	65	100	100
- stage 3Nm	Bolts: + 90°	Bolts: + 90°	+ 90°	+ 90°
- stage 4Nm	Bolts: + 90°	Bolts: + 90°	+ 90°	+ 90°
- stage 5Nm	Nuts: + 40° + 40°	Nuts: + 40° + 40°	Bolts 11 to 15: 30	Bolts 11 to 15: 30
- stage 6Nm	Bolts 11 to 14: 30	Bolts 11 to 14: 30	-	-
Big-end bearings.....Nm	51 N	51 N	25 + 50° N	25 + 50° N
Main bearings.....Nm	80	80	113	113
Crankshaft pulley boltNm	137	137	190	190
Camshaft pulley boltNm	118	118	118	118
Flywheel [driveplate] bolt.....Nm	83	83	83	142
Front hubsNm	220	294	294	294
Rear hubsNm	70	216	216	216
Wheel nuts / boltsNm	90	86	86	86
Glow plugsNm	15	15	15	15
Clutch pressure plate boltsNm	16	16	16	16
Injection pump sprocket.....Nm	49	49	50	49
Injectors.....Nm	55	55	55	55
Injection pump mounting boltsNm	29	29	25	25
Injector pipe unions.....Nm	24	24	24	24
Capacities				
Engine oil & filter.....litres	4.1	4.1	4.9	4.1
Gearbox.....litres	2.4	2.4	3.3	2.0
Automatic transmissionlitres	-	-	-	-
Final drivelitres	WT	WT	WT	WT
Cooling system.....litres	5.6	8.0	8.9	8.9
Fuel tank.....litres	32 Van: 40	42	42	42

Notes



1301 cm³



1347 cm³ / 1697 cm³

- Not applicable, or information not available



	Uno 1.7 1990 to 1991	Punto D S 1996 to 1997	Punto TD 60 S 1996 to 1999	Punto TD 70 SX 1996 to 1999
Engine				
Engine type/code.....	146 B2.000 OHC 42kW	176 B3.000 SOHC 42kW	176 B7.000 Turbo 46kW	176 A3.000 Turbo 51kW
Capacity (cm ³) / cylinders.....	1697 / 4	1698 / 4	1698 / 4	1698 / 4
Compression ratio / pressure.....bar	20.5 ± 0.5 / _	20.3 /	20.3 /	20.3 /
Torque outputNm	0	0	118	134
Oil pressureidle [running] bar	[3.4 to 4.9]	[3.4]	[3.4]	[3.4]
Oil temperature°C	100	100	100	100
Valve clearances - inlet (mm).....	0.30 ± 0.05	0.30 ± 0.05	0.30 ± 0.05	0.30 ± 0.05
- exhaust (mm).....	0.35 ± 0.05	0.35 ± 0.05	0.35 ± 0.05	0.35 ± 0.05
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	78 to 82	78	78	78
Radiator cap pressure.....bar	0.78	0.98	0.98	0.98
Fuel system				
Idle speedrpm	810 ± 20	800 ± 50	900	900
Maximum (no load) speedrpm	5150 ± 50	5250	5250	5250
Smoke test/opacityM ⁻¹ %	2.5	1.85	1.89	1.35
Static timing method.....	Refer to text	Dial gauge	Plunger travel	Plunger travel
Timing dimension.....mm	[0 ± 1]	Dimension on pump	0.94 ± 0.05	0.94 ± 0.05
Crankshaft positionmm [°]	0 TDC	TDC	TDC	TDC
Turbo type / ref / pressure.....bar	_	_	TBO 227	0.75 bar
Injection pump make.....	Roto Diesel	CAV	Bosch	Bosch
Injection pump part no.....	B 571B (FT01 E FT02)	FT08	VER 691	VER 537-1
Injector Make / type.....	Roto Diesel	CAV	Bosch	Bosch
Injector part no.....	BDNOSDC6751C'	6732 604C	DN 12 SD 290	DN 12 SD 290
Injection type.....	DPCR 8443	Indirect FT08	Bosch VE	Indirect VER
Injection opening pressure, New [used]...bar	124 to 131 ²	124 to 131 [116 to 123]	150	150
Glow plugs				
Maker.....	Marelli/Champion	Bosch	Bosch	Bosch
Type.....	UX2A / CH68	0250 201 33	0250 001 538	0250 201 033
Nominal rating.....V/A	_	_	_	_
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.5	1.5	1.5
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	155/70x13	165/65x14	165/65x14	165/65x14
Pressure - front / rear - Saloon / Hatch...bar	2.0 / 1.9	2.4 / 2.0	2.4 / 2.0	2.4 / 2.0
- Estate / Van.....bar	_	_	_	_
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 ± 1.0	0.0 ± 1.0	0.0 ± 1.0	0.0 ± 1.0
Camber.....	-30' ± 30'	-0°15' ± 30'	-0°15' ± 30'	-0°15' ± 30'
Castor.....	2°10' ± 30'	2°30' ± 30'	2°50' ± 30'	2°50' ± 30'
King pin inclination.....	_	_	_	_
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	_	1.3 ± 2.0	1.0 ± 2.0	1.0 ± 2.0
Camber.....	_	-0°15' ± 30'	0°15' ± 30'	-0°15' ± 30'



FIAT

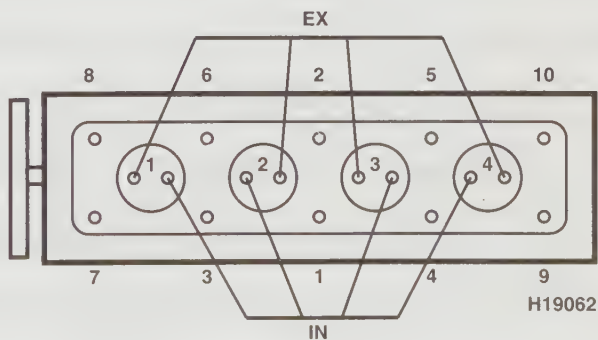
	Uno 1.7 1990 to 1991	Punto D S 1996 to 1997	Punto TD 60 S 1996 to 1999	Punto TD 70 SX 1996 to 1999
Torque wrench settings				
Cylinder head - stage 1Nm	50	100	100	100
- stage 2Nm	100	+ 90°	+ 90°	+ 90°
- stage 3Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4Nm	+ 90°	-	-	-
- stage 5Nm	Bolts 11 to 15: 30	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	25 + 50° N	25 + 50° N	25 + 50° N	25 + 50° N
Main bearings.....Nm	113	113	113	113
Crankshaft pulley boltNm	190	190	190	190
Camshaft pulley boltNm	118	120	120	120
Flywheel [driveplate] bolt.....Nm	142	142	142	142
Front hubsNm	294	280 N	280 N	280 N
Rear hubsNm	216	280 N	280 N	280 N
Wheel nuts / boltsNm	86	85	85	85
Glow plugsNm	15	15	15	15
Clutch pressure plate boltsNm	16	-	-	-
Injection pump sprocket.....Nm	49	49	-	49
Injectors.....Nm	55	55	55	55
Injection pump mounting boltsNm	25	25	-	30
Injector pipe unions.....Nm	24	25	25	25
Capacities				
Engine oil & filter.....litres	4.1	4.8	4.8	4.84
Gearbox.....litres	2.0	1.98	1.98	1.98
Automatic transmissionlitres	-	-	-	-
Final drivelitres	WT	WT	WT	WT
Cooling system.....litres	8.9	7.2	7.2	1.98
Fuel tank.....litres	42	47	47	47

Notes

Uno 1.7 1990 to 1991

*Also RDNOS6751C

*RDNOS6751C: 116 to 123



1697 cm³ / 1698 cm³

- Not applicable, or information not available



FIAT

	Tipo 1.7 1988 to 1992	Tipo 1.7 1988 to 1992	Tipo 1.7 1993 to 1995	Tipo 1.7 1993 to 1995
Engine				
Engine type/code.....	149 B4.000 SOHC 42kW	149 B4.000 SOHC 42kW	149 B4.000 SOHC 42kW	149 B4.000 SOHC 42kW
Capacity (cm ³) / cylinders.....	1697 / 4	1697 / 4	1697 / 4	1697 / 4
Compression ratio / pressurebar	20.5 ± 0.5 / _	20.5 ± 0.5 / _	20.5 ± 0.5 / _	20.5 ± 0.5 / _
Torque outputNm	100	100	100	100
Oil pressureidle [running] bar	[3.4 to 4.9]	[3.4 to 4.9]	[3.4 to 4.9]	[3.4 to 4.9]
Oil temperature°C	100	100	100	100
Valve clearances - inlet (mm).....	0.30 ± 0.05	0.30 ± 0.05	0.30 ± 0.05	0.30 ± 0.05
- exhaust (mm).....	0.35 ± 0.05	0.35 ± 0.05	0.35 ± 0.05	0.35 ± 0.05
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	78 to 82	78 to 82	78 to 82	78 to 82
Radiator cap pressurebar	0.78	0.78	0.78	0.78
Fuel system				
Idle speedrpm	790 to 840	760 ± 20	880 to 920	790 to 840
Maximum (no load) speedrpm	5100 to 5200	5150 ± 50	5150 ± 50	5150 ± 50
Smoke test/opacityM ⁻¹ %	1.78	1.78	1.78	1.78
Static timing method.....	Refer to text	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	Dimension on pump	1.0 [2 ± 1 ATDC]	1.0 [2 ± 1 ATDC]	Dimension on pump
Crankshaft positionmm [°]	0 TDC	0 TDC	0 TDC	0 TDC
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make.....	Roto Diesel	Bosch	Bosch	CAV
Injection pump part no.....	FT01	-	0460 484 051	R8443B572C
Injector Make / type.....	Roto Diesel	Bosch	Bosch	CAV
Injector part no.....	BDNOSDC6751C	DN 12 SD 290	0432 217 195	LCR 67326
Injection type.....	DPCR 8443	VE R 308	VE R 463	CAV DPC
Injection opening pressure, New [used]...bar	≥124 [116]	135 to 143	125 to 133	124 to 131 [119]
Glow plugs				
Maker.....	Bosch	Bosch	Bosch	Bosch
Type.....	0250 201 005	0250 201 005	0250 201 019	0250 201 019
Nominal ratingV/A	11 / 12	11 / 12	11 / 12	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.5	1.5	1.5
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	-	-	-	-
Pressure - front / rear - Saloon / Hatch...bar	2.1 / 1.9	2.1 / 1.9	2.1 / 1.9	2.1 / 1.9
- Estate / Vanbar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 1.0	0 ± 1.0	0 ± 1.0	0 ± 1.0
Camber.....	25' ± 30'	25' ± 30'	25' ± 30'	25' ± 30'
Castor.....	1°40' ± 30'	1°40' ± 30'	1°40' ± 30'	1°40' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 2.0	0 ± 2.0	0 ± 2.0	0 ± 2.0
Camber.....	-1°30' ± 15'	-1°30' ± 15'	-1°30' ± 15'	-1°30' ± 15'



FIAT

	Tipo 1.7 1988 to 1992	Tipo 1.7 1988 to 1992	Tipo 1.7 1993 to 1995	Tipo 1.7 1993 to 1995
Torque wrench settings				
Cylinder head - stage 1Nm	50	50	50	50
- stage 2Nm	100	100	100	100
- stage 3Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5Nm	Bolts 11 to 15: 30	Bolts 11 to 15: 30	Bolts 11 to 15: 30	Bolts 11 to 15: 30
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	74 N	74 N	25 + 50° N	25 + 50° N
Main bearings.....Nm	113	113	113	113
Crankshaft pulley boltNm	190	190	190	190
Camshaft pulley boltNm	118	118	118	118
Flywheel [driveplate] bolt.....Nm	142	142	142	142
Front hubsNm	250 ¹	250 ²	240	240
Rear hubsNm	280	280	280	280
Wheel nuts / boltsNm	86	86	86	86
Glow plugsNm	15	15	15	15
Clutch pressure plate boltsNm	M6: 17 M8: 30	M6: 17 M8: 30	38	38
Injection pump sprocket.....Nm	49	49	49	49
Injectors.....Nm	55	55	55	55
Injection pump mounting boltsNm	25	25	25	25
Injector pipe unions.....Nm	24	24	24	24
Capacities				
Engine oil & filter.....litres	5.0	5.0	5.0	5.0
Gearbox.....litres	1.4	1.4	1.4	1.4
Automatic transmissionlitres	-	-	-	-
Final drivelitres	WT	WT	WT	WT
Cooling system.....litres	8.0	8.0	8.0	8.0
Fuel tank.....litres	55	55	55	55

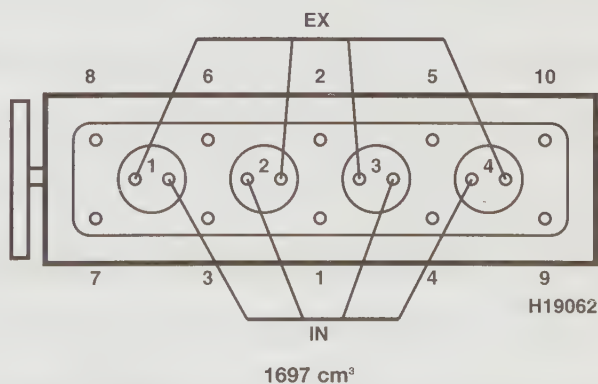
Notes

Tipo 1.7 1988 to 1992

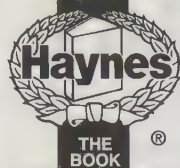
¹1990 ►, with integral washers: 235

Tipo 1.7 1988 to 1992

²1990 ►, with integral washers: 235



- Not applicable, or information not available



FIAT

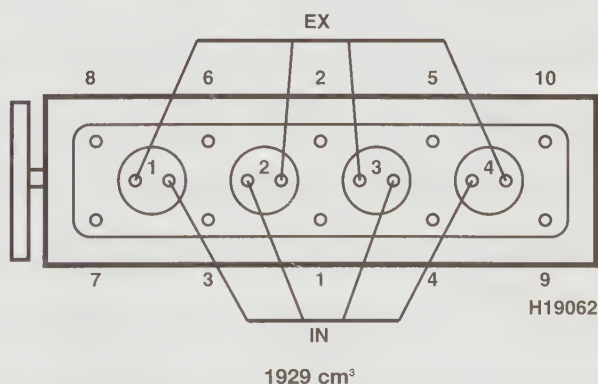
	Tipo 1.9 Turbo 1988 to 1992	Tipo 1.9 1990 to 1992	Tipo 1.9 Turbo EGR 1990 to 1992	Tipo 1.9 Turbo 1990 to 1992
Engine				
Engine type/code	160 A6.000 SOHC Turbo 66kW	160 A7.000 SOHC 48kW	160 B6.046 SOHC Turbo 59kW	160 A6.046 SOHC Turbo 66kW
Capacity (cm ³) / cylinders	1929 / 4	1929 / 4	1929 / 4	1929 / 4
Compression ration / pressure	19.2 ± 0.5 / _	19.2 ± 0.5 / _	19.2 ± 0.5 / _	19.2 ± 0.5 / _
Torque output	186	0	0	186
Oil pressureidle [running] bar	[3.4 to 4.9]	[3.4 to 4.9]	[3.4 to 4.9]	[3.4 to 4.9]
Oil temperature°C	100	100	100	100
Valve clearances - inlet (mm)	0.30 ± 0.05	0.30 ± 0.05	0.30 ± 0.05	0.30 ± 0.05
- exhaust (mm)	0.35 ± 0.05	0.35 ± 0.05	0.35 ± 0.05	0.35 ± 0.05
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	78 to 82	78 to 82	78 to 82	78 to 82
Radiator cap pressurebar	0.78	0.78	0.78	0.78
Fuel system				
Idle speedrpm	900 ± 20	740 to 780	740 to 780	830 ± 20
Maximum (no load) speedrpm	4860 to 4940	4860 to 4940	4860 to 4940	5000 ± 50
Smoke test/opacityM ⁻¹ %	1.78	1.82	1.16	1.78
Static timing method	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimensionmm	0.82 [3 ± 1 ATDC]	0.82	0.82	0.82
Crankshaft positionmm [°]	0 TDC	0 TDC	0 TDC	0 TDC
Turbo type / ref / pressurebar	0.8 bar @ 2000 rpm	-	-	-
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.	-	-	-	-
Injector Make / type	Bosch	Bosch	Bosch	Bosch
Injector part no.	DN 12 SD 283	DN 12 SD 283	DN 12 SD 283	DNOSD 1510
Injection type	VE R 303	VE R 303	VE R 303	VE 4/R 343
Injection opening pressure, New [used]...bar	150 to 158	150 to 158	150 to 158	150 to 158
Glow plugs				
Maker	Bosch	Bosch	Bosch	Beru
Type	0250 201 005	0250 201 005	0250 201 005	0100221166
Nominal ratingV/A	11 / 12	11 / 12	11 / 12	-
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.5	1.5	1.5
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	-	-	-	-
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.2	2.2 / 2.2	2.2 / 2.2	2.1 / 2.1
- Estate / Vanbar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 1.0	0 ± 1.0	0 ± 1.0	-1.0 to 1.0
Camber	25' ± 30'	25' ± 30'	25' ± 30'	-4' ± 20'
Castor	2°50' ± 30'	2°50' ± 30'	2°50' ± 30'	3°11' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 2.0	0 ± 2.0	0 ± 2.0	-1.0 ± 2.0
Camber	-1°30' ± 15'	-1°30' ± 15'	-1°30' ± 15'	-1° ± 15'



FIAT

	Tipo 1.9 Turbo 1988 to 1992	Tipo 1.9 1990 to 1992	Tipo 1.9 Turbo EGR 1990 to 1992	Tipo 1.9 Turbo 1990 to 1992
Torque wrench settings				
Cylinder head - stage 1Nm	50	50	50	50
- stage 2Nm	100	100	100	100
- stage 3Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5Nm	Bolts 11 to 15: 30	Bolts 11 to 15: 30	Bolts 11 to 15: 30	Bolts 11 to 15: 30
- stage 6Nm	-	-	-	-
Big-end bearingsNm	25 + 50° N	25 + 50° N	25 + 50° N	25 + 50° N
Main bearingsNm	113	113	113	113
Crankshaft pulley boltNm	190	190	190	190
Camshaft pulley boltNm	118	118	118	118
Flywheel [driveplate] boltNm	142	142	142	142
Front hubsNm	460	460	460	460
Rear hubsNm	280	280	280	280
Wheel nuts / boltsNm	86	86	86	86
Glow plugsNm	15	15	15	15
Clutch pressure plate boltsNm	M6: 17 M8: 30	M6: 17 M8: 30	M6: 17 M8: 30	M6: 17 M8: 30
Injection pump sprocketNm	49	49	49	49
InjectorsNm	55	55	55	55
Injection pump mounting boltsNm	25	25	25	25
Injector pipe unionsNm	24	24	24	24
Capacities				
Engine oil & filterlitres	5.0	5.0	5.0	5.0
Gearboxlitres	1.4	1.4	1.4	1.4
Automatic transmissionlitres	-	-	-	-
Final drivelitres	WT	WT	WT	WT
Cooling systemlitres	8.8	8.8	8.8	8.8
Fuel tanklitres	55	55	55	55

Notes



- Not applicable, or information not available



FIAT

	Tipo 1.9 Turbo 1993 to 1995	Bravo & Brava 1.9D 1996 to 2000	Bravo & Brava 1.9TD 75 1996 to 2000	Bravo & Brava 1.9TD 100 1996 to 2000
Engine				
Engine type/code	160 A6.000 SOHC Turbo 66kW	160 A7.000 SOHC 48kW	182 A8.000 SOHC Turbo 55kW	182 A7.000 SOHC Turbo 74kW
Capacity (cm ³) / cylinders	1929 / 4	1929 / 4	1910 / 4	1910 / 4
Compression ration / pressure	19.2 ± 0.5 / _	21.0 / _	20.7 / _	20.7 / _
Torque outputNm	186	119	147	200
Oil pressureidle [running] bar	[3.4 to 4.9]	[3.7]	[3.7]	[3.7]
Oil temperature°C	100	100	100	100
Valve clearances - inlet (mm)	0.30 ± 0.05	0.30 ± 0.05	0.35 ± 0.05	0.35 ± 0.05
- exhaust (mm)	0.35 ± 0.05	0.35 ± 0.05	0.35 ± 0.05	0.35 ± 0.05
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	78 to 82	81	81	81
Radiator cap pressurebar	0.78	0.98	0.98	0.98
Fuel system				
Idle speedrpm	900 ± 20	800 ± 20	850 ± 20	860 ± 10
Maximum (no load) speedrpm	5000	5050 ± 50	5050 ± 50	4970 ± 50
Smoke test/opacityM ⁻¹ %	1.85	2.0	2.0	2.0
Static timing method.....	Plunger travel	Plunger travel	-	-
Timing dimension.....mm	0.8 ± 0.05	0.92 ± 0.05	0.87 to 0.97	0.87 to 0.97
Crankshaft positionmm [°]	0 TDC	TDC	WSM	WSM
Turbo type / ref / pressure	0.8 bar @ 2000 rpm	-	Garrett GT15 ≤1.05 bar	Garrett GT15 ≤1.05 bar
Injection pump make	Bosch	Lucas	Bosch	Lucas
Injection pump part no.....	0460 494 304	FT 08	VER 679	DPC FT09
Injector Make / type	Bosch	CAV	Bosch	CAV
Injector part no.....	0432 217 211	LCR 6734 202D	KCA 30S41	RDN 05DC6897
Injection type.....	VE R 466	Indirect	Indirect	Indirect
Injection opening pressure, New [used]...bar	150 to 158	124 to 131 [116 to 123]	150 to 158	143 to 150
Glow plugs				
Maker	Bosch	Beru/Champion	Beru	Beru
Type	0250 001 538	0 100 221 145 / CH 68	0 100 226 249	0 100 226 249
Nominal rating.....V/A	11 / 18	-	-	-
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.5	1.5	1.5
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175/65x14	165/65x14; 175/65x14'	165/65x14; 175/65x14'	175/65x14; 185/60x14
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.2	2.3 / 2.2	2.3 / 2.2	2.3 / 2.2
- Estate / Vanbar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 1.0	0 ± 1.0	0 ± 1.0	0 ± 1.0
Camber	10' ± 30'	-7' ± 30'	-7' ± 30'	-7' ± 30'
Castor	2°0' ± 50'	2°50' ± 30'	2°42' ± 30'	2°50' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1 ± 2.0	-2.5 to 1.5	-2.5 to 1.5	-2.5 to 1.5
Camber	-1°0' ± 30'	-1° ± 30'	-1° ± 30'	-1° ± 30'



FIAT

	Tipo 1.9 Turbo 1993 to 1995	Bravo & Brava 1.9D 1996 to 2000	Bravo & Brava 1.9TD 75 1996 to 2000	Bravo & Brava 1.9TD 100 1996 to 2000
Torque wrench settings				
Cylinder head - stage 1Nm	50	50	65	65
- stage 2Nm	100	+ 90°	+ 90°	+ 90°
- stage 3Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5Nm	Bolts 11 to 15: 30	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	25 + 50° N	25 + 50° N	20 + 60° N	20 + 60° N
Main bearings.....Nm	113	20 + 100°	20 + 100°	20 + 100°
Crankshaft pulley boltNm	190	190	360 Left-hand	360 Left-hand
Camshaft pulley boltNm	118	120	120	120
Flywheel [driveplate] bolt.....Nm	142	142	160	160
Front hubsNm	460	240	280	280
Rear hubsNm	280	280	280	280
Wheel nuts / boltsNm	86	86	86	86
Glow plugsNm	15	15	15	15
Clutch pressure plate boltsNm	M6: 17 M8: 30	38	38	38
Injection pump sprocket.....Nm	49	50	50	50
Injectors.....Nm	55	55	55	55
Injection pump mounting boltsNm	25	25	25	25
Injector pipe unions.....Nm	24	29	29	29
Capacities				
Engine oil & filter.....litres	5.0	4.9	4.8	4.8
Gearbox.....litres	1.4	1.98	1.98	1.98
Automatic transmissionlitres	-	-	-	-
Final drivelitres	WT	WT	WT	WT
Cooling system.....litres	8.8	7.4	6.3	6.3
Fuel tank.....litres	55	60	60	60

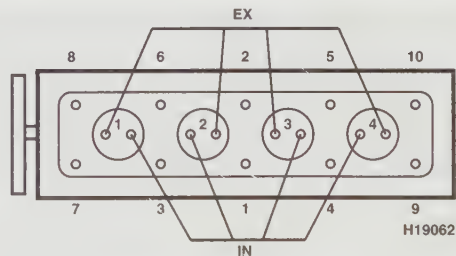
Notes

Bravo & Brava 1.9D 1996 to 2000

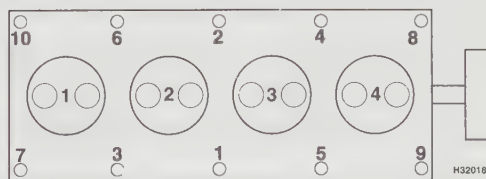
'Also 185/60x14: 195/50x15

Bravo & Brava 1.9TD 75 1996 to 2000

'Also 185/60x14: 195/50x15



Tipo 1929 cm³



1910 cm³ / 1929 cm³

- Not applicable, or information not available



FIAT

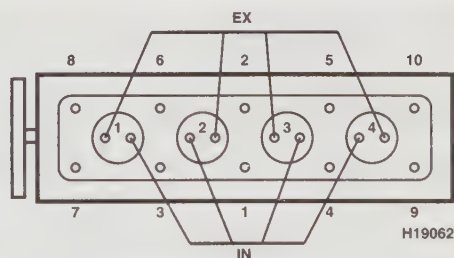
	Bravo & Brava 1.9 JTD 105 1999 to 2000	Tempra 2.0 DS 1990 to 1996	Tempra 2.0 DS 1990 to 1996	Tempra 2.0 Turbo DS 1990 to 1996
Engine				
Engine type/code.....	182 B4.000 SOHC Turbo 77kW	160 A7.000 SOHC 48kW	160 A7.000 SOHC 48kW	160 A6.000 SOHC Turbo 66kW
Capacity (cm ³) / cylinders.....	1910 / 4	1929 / 4	1929 / 4	1929 / 4
Compression ration / pressurebar	18.45 / _	21.0 ± 0.5 / _	21.0 ± 0.5 / _	19.2 ± 0.5 / _
Torque outputNm	200	119	119	191
Oil pressureidle [running] bar	[3.43 to 4.9]	[3.4 to 4.9]	[3.4 to 4.9]	[3.4 to 4.9]
Oil temperature°C	100	100	100	100
Valve clearances - inlet (mm).....	0.30 ± 0.05	0.30 ± 0.05	0.30 ± 0.05	0.30 ± 0.05
- exhaust (mm).....	0.35 ± 0.05	0.35 ± 0.05	0.35 ± 0.05	0.35 ± 0.05
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	86 to 90	78 to 82	78 to 82	78 to 82
Radiator cap pressurebar	0.9 to 1.1	0.78	0.78	0.78
Fuel system				
Idle speedrpm	800 ± 30	760 to 800	740 to 780	880 to 920
Maximum (no load) speedrpm	ECU controlled	5100 to 5200	5120 to 5200	4950 to 5050
Smoke test/opacityM-1 %	2.0	1.8	1.8	1.88
Static timing method.....	-	Plunger travel	Rotor groove	Plunger travel
Timing dimension.....mm	-	0.85	Dimension on pump	0.8
Crankshaft positionmm [°]	-	0 TDC	-	0 TDC
Turbo type / ref / pressurebar	-	-	-	KKK K16 ≤0.8 bar @ 2400rpm
Injection pump make.....	Bosch	Bosch	Roto Diesel	Bosch
Injection pump part no.....	EDC 15C	0460 484 024	-	VER 466
Injector Make / type.....	-	Bosch	Roto Diesel	Bosch
Injector part no.....	0.445.110.002	DN 12 SD 290	RDN or BDN 12SDC 6849C	DN 12 SD 290
Injection type.....	Direct common rail EDC 15C	VE R 334	FT 03	Indirect VER
Injection opening pressure, New [used]...bar	-	125 to 133	124 to 131 [119 to 131]	150 to 158
Glow plugs				
Maker.....	Bosch	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type.....	0250 202 028	0250 201 005 / CH68	0250 201 005 / CH68	0250 201 005 / CH68
Nominal rating.....V/A	-	11 / 12	11 / 12	11 / 18
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.5	1.5	1.5
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185/55x15: 185/60x14	175/65x14: 185/60x14	175/65x14: 185/60x14	175/65x14: 185/60x14
Pressure - front / rear - Saloon / Hatch...bar	2.3 / 2.2	2.2 / 2.2	2.2 / 2.2	2.2 / 2.2
- Estate / Vanbar	-	-	2.2 / 2.2	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 1.0	0 ± 1.0	0 to 1.0	0 ± 1.0
Camber.....	-7' ± 30'	10' ± 30'	10' ± 30'	10' ± 30'
Castor.....	2°50' ± 30'	2°40' ± 30'	2°40' ± 30' Est: 2°20' ± 30'	2°50' to 3°50'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.0 to 4.0	-3.0 to 1.0	-3.0 to 1.0	-3.0 to 1.0
Camber.....	-0°46' ± 30'	-1° ± 30'	-1° ± 30'	-30' to -1°30'



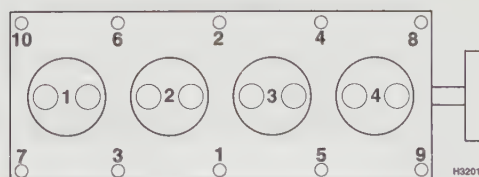
FIAT

	Bravo & Brava 1.9 JTD 105 1999 to 2000	Tempra 2.0 DS 1990 to 1996	Tempra 2.0 DS 1990 to 1996	Tempra 2.0 Turbo DS 1990 to 1996
Torque wrench settings				
Cylinder head - stage 1Nm	65	50	50	50
- stage 2Nm	+ 90°	100	100	100
- stage 3Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5Nm	–	Bolts 11 to 15: 30	Bolts 11 to 15: 30	Bolts 11 to 15: 30
- stage 6Nm	–	–	–	–
Big-end bearings.....Nm	25 + 60° N	25 + 50° N	25 + 50° N	25 + 50° N
Main bearings.....Nm	20 + 100°	113	113	113
Crankshaft pulley boltNm	360 Left-hand	190	190	190
Camshaft pulley boltNm	120	118	118	118
Flywheel [driveplate] bolt.....Nm	160	142	142	142
Front hubsNm	70 + 55° M24: 70 + 62°	235	235	451
Rear hubsNm	284	284	284	284
Wheel nuts / boltsNm	86	86	86	86
Glow plugsNm	15	15	15	15
Clutch pressure plate boltsNm	38	38	38	38
Injection pump sprocket.....Nm	50	49	49	49
Injectors.....Nm	32	55	55	55
Injection pump mounting boltsNm	32	25	25	25
Injector pipe unions.....Nm	32	24	24	24
Capacities				
Engine oil & filter.....litres	4.9	5.0	5.0	5.0
Gearbox.....litres	2.0	2.0	2.0	2.0
Automatic transmissionlitres	–	–	–	–
Final drivelitres	WT	WT	WT	WT
Cooling system.....litres	6.3	8.0	8.0	8.9
Fuel tank.....litres	60	65	65	65

Notes

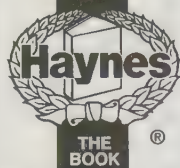


1929 cm³



1910 cm³

– Not applicable, or information not available



FIAT

	Tempra 2.0 Turbo DS 1993 to 1996	Marea & Weekend 1.9 TD75 1997 to 1999	Marea & Weekend 1.9 TD100 1997 to 1999	Marea & Weekend JTD 105 1999 to 2000
Engine				
Engine type/code.....	160 D1.000 SOHC Turbo 66kW	182 A8.000 SOHC Turbo 55kW	182 A7.000 SOHC Turbo 74kW	182 B4.000 SOHC Turbo 77kW
Capacity (cm ³) / cylinders.....	1929 / 4	1910 / 4	1910 / 4	1910 / 4
Compression ration / pressurebar	19.2 ± 0.5 / _	20.7 /	20.7 /	18.45 /
Torque outputNm	191	147	200	200
Oil pressureidle [running] bar	[3.4 to 4.9]	[3.7]	[3.7]	[3.43 to 4.9]
Oil temperature°C	100	100	100	100
Valve clearances - inlet (mm)	0.30 ± 0.05	0.30 ± 0.05	0.30 ± 0.05	0.30 ± 0.05
- exhaust (mm)	0.35 ± 0.05	0.35 ± 0.05	0.35 ± 0.05	0.35 ± 0.05
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	78 to 82	81	81	86 to 90
Radiator cap pressurebar	0.78	0.98	0.98	0.98
Fuel system				
Idle speedrpm	850 to 950	830 to 870	830 to 870	830 ± 30
Maximum (no load) speedrpm	4950 to 5050	5100	4920 to 5020	-
Smoke test/opacityM ⁻¹ %	1.58	2.0	1.16	2.0
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Refer to wsm
Timing dimension.....mm	0.8	0.92	-	-
Crankshaft positionmm [°]	0 TDC	TDC	-	-
Turbo type / ref / pressurebar	KKK K16 ≤0.8 bar @ 2400rpm	Garrett GT15 ≤1.05 bar	Garrett GT15 ≤1.05 bar	-
Injection pump make	Bosch	Bosch	Lucas	Bosch
Injection pump part no.....	VER 508	VER 679	DPC FT09	EDC 15C
Injector Make / type.....	Bosch	Bosch	-	-
Injector part no.....	DN 12 SD 290	DNOSD321	RDN SDC6888D	-
Injection type.....	Indirect VER	Indirect VER	Indirect DPC	Direct common rail EDC 15C
Injection opening pressure, New [used]...bar	150 to 158	150 to 158	143 to 150	-
Glow plugs				
Maker	Bosch/Champion	Beru	Beru	Bosch
Type	0250 201 005 / CH68	0 100 226 249	0100 226 249	0250 202 028
Nominal rating.....V/A	11 / 18	-	-	-
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.5	1.5	1.5
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175/65x14: 185/60x14	175/70x14	165/65x14: 175/65x14'	175/70x14: 185/65x14
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.2	2.1 2.3	2.2 / 2.1	2.2 / 2.1
- Estate / Vanbar	-	-	2.2 / 2.2	2.2 / 2.2
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 1.0	0 ± 1.0	0 ± 1.0	0 ± 1.0
Camber	10' ± 30'	-7' ± 30'	-7' ± 30'	-7' ± 30'
Castor	2°50' to 3°50'	2°50' ± 30'	2°40' ± 30' Est: 2°20' ± 30'	2°42' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-3.0 to 1.0	-2.5 to 1.5	-2.5 to 1.5	-2.5 to 1.5
Camber	-30' to -1°30'	-1° ± 30'	-1° ± 30'	-1° ± 30'



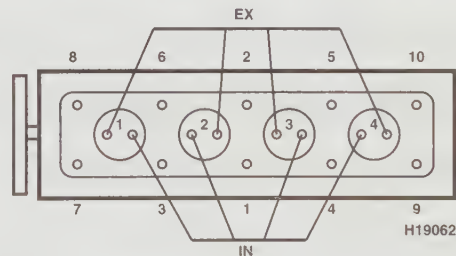
FIAT

	Tempra 2.0 Turbo DS 1993 to 1996	Marea & Weekend 1.9 TD75 1997 to 1999	Marea & Weekend 1.9 TD100 1997 to 1999	Marea & Weekend JTD 105 1999 to 2000
Torque wrench settings				
Cylinder head - stage 1Nm	50	60 N	65 N	65
- stage 2Nm	100	+ 90°	+ 90°	+ 90°
- stage 3Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5Nm	Bolts 11 to 15: 30	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearingsNm	25 + 50° N	25 + 90° N	25 + 60° N	20 + 60° N
Main bearingsNm	113	20 + 100°	20 + 100°	20 + 100°
Crankshaft pulley boltNm	190	360 left-hand	360 left-hand	360 Left-hand
Camshaft pulley boltNm	118	120	120	120
Flywheel [driveplate] boltNm	142	142	142	160
Front hubsNm	451	240	240	240
Rear hubsNm	284	284	284	-
Wheel nuts / boltsNm	86	86	86	86
Glow plugsNm	15	15	15	15
Clutch pressure plate boltsNm	38	38	38	38
Injection pump sprocketNm	49	50	50	50
InjectorsNm	55	78	78	32
Injection pump mounting boltsNm	25	25	25	32
Injector pipe unionsNm	24	29	29	32
Capacities				
Engine oil & filterlitres	5.0	4.3	4.3	4.9
Gearboxlitres	2.0	2.0	2.0	2.0
Automatic transmissionlitres	-	-	-	-
Final drivelitres	WT	WT	WT	WT
Cooling systemlitres	8.9	6.0	6.0	6.3
Fuel tanklitres	65	50	50	50

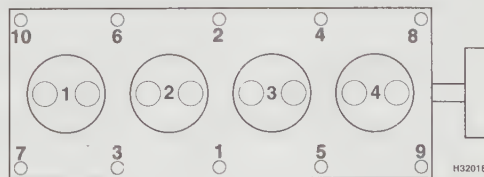
Notes

Marea & Weekend 1.9 TD100 1997 to 1999

*Also 185/60x14; 195/50x15



1929 cm³



1910 cm³

- Not applicable, or information not available



FIAT

	Marea & Weekend 2.4TD 1997 to 1999	Croma 1.9 Turbo D 1988 to 1992	Croma 2500 Turbo D 1989 to 1993	Croma 2500 Turbo D 1990 to 1993
Engine				
Engine type/code.....	182 A2 000 SOHC Turbo 91kW	154 B.000 SOHC Turbo 66kW	8144.97 SOHC Turbo 85kW	8144.97R SOHC Turbo 80kW US83
Capacity (cm ³) / cylinders.....	2387 / 5	1929 / 4	2499 / 4	2499 / 4
Compression ratio / pressure.....bar	20.7 /	18.0 /	21.0 /	21.0 /
Torque outputNm	265	191	0	0
Oil pressureidle [running] bar	2.0 [4.0]	[3.4 to 4.9]	[3.4 to 4.9]	[3.4 to 4.9]
Oil temperature°C	100	100	100	100
Valve clearances - inlet (mm).....	0.30 ± 0.05	0.40 ± 0.05	0.50 ± 0.05	0.50 ± 0.05
- exhaust (mm).....	0.35 ± 0.05	0.40 ± 0.05	0.50 ± 0.05	0.50 ± 0.05
Injection order.....	1-2-4-5-3	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	81	78 to 82	77 to 81	77 to 81
Radiator cap pressurebar	0.98	0.78	0.78	0.78
Fuel system				
Idle speedrpm	830 to 870	740 to 780	800 to 850	740 to 780
Maximum (no load) speedrpm	5050 to 5150	4860 to 4940	5100 to 5200	5100 to 5200
Smoke test/opacityM ⁻¹ %	1.13	2.5	2.5	2.0
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	0.75	0.82	1.0 ± 0.04	0.75 ± 0.04
Crankshaft positionmm [°]	TDC	0 TDC	0 TDC	0 TDC
Turbo type / ref / pressure.....bar	IHI VL6 ≤1.05 bar		0.95 bar @ 2400rpm	-
Injection pump make.....	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VER 560	0460 414 056	VER 4/10	VER 361
Injector Make / type.....	Bosch	Bosch	Bosch	Bosch
Injector part no.....	DN12 SD290	DN 12 SD 283	DNOSD 259	DNOSD 259
Injection type.....	Indirect VER	VE R 303	Indirect VER	Indirect VER
Injection opening pressure, New [used]...bar	150 to 158	150 to 158	150 to 158 [135]	150 to 158
Glow plugs				
Maker.....	Beru	Bosch	Beru/Champion	Bosch
Type.....	0100 226 249	0250 201 025	0100 221 167 / CH88	0250 201 006
Nominal rating.....V/A	-	-	11 / 12	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.5	1.5	1.5
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/55x15: 205/50x15	185/65x14: 195/60x14	185/65x14: 195/60x14	185/65x14: 195/60x14
Pressure - front / rear - Saloon / Hatch...bar	2.5 / 2.2	2.2 / 2.2	2.2 / 2.2	2.2 / 2.2
- Estate / Van.....bar	2.5 / 2.3	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 1.0	-1.0 to 1.0	-1.0 to 1.0	-1.0 to 1.0
Camber.....	10' ± 30'	-40' to 0'	-40' to 0'	-40' to 0'
Castor.....	2°40' ± 30' Est: 2°20' ± 30'	2°30' to 3°10'	2°30' to 3°10'	2°30' to 3°10'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-2.5 to 1.5	2.0 to 5.0	2.0 to 5.0	2.0 to 5.0
Camber.....	-1° ± 30'	-40' to 0'	-40' to 0'	-40' to 0'



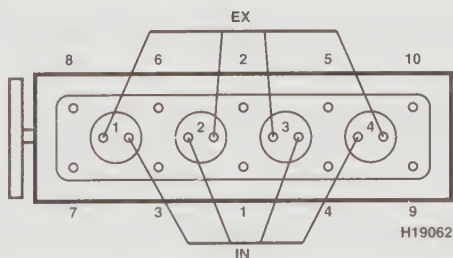
FIAT

	Marea & Weekend 2.4TD 1997 to 1999	Croma 1.9 Turbo D 1988 to 1992	Croma 2500 Turbo D 1989 to 1993	Croma 2500 Turbo D 1990 to 1993
Torque wrench settings				
Cylinder head - stage 1Nm	65	50	60	40
- stage 2Nm	+ 90°	100	Slacken	Slacken
- stage 3Nm	+ 90°	+ 90°	60	40
- stage 4Nm	+ 90°	+ 90°	+ 180°	+ 180°
- stage 5Nm	-	Bolts 11 to 15: 30	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	20 + 60° N	25 + 50° N	115 N	115 N
Main bearings.....Nm	20 + 100°	113	80, 160	80, 160
Crankshaft pulley boltNm	360 Left-hand	190	205	205
Camshaft pulley boltNm	120	118	25	25
Flywheel [driveplate] bolt.....Nm	160	142	125	125
Front hubsNm	235	450 LkC ¹	450 LkC	450 LkC
Rear hubsNm	280	320	320	320
Wheel nuts / boltsNm	86	98	98	98
Glow plugsNm	15	15	37	37
Clutch pressure plate boltsNm	38	M6: 17. M8: 30	20	20
Injection pump sprocket.....Nm	50	49	25	25
Injectors.....Nm	55	55	35	35
Injection pump mounting boltsNm	25	25	25	25
Injector pipe unions.....Nm	-	24	-	-
Capacities				
Engine oil & filter.....litres	5.0	5.0	6.4	5.5
Gearbox.....litres	2.0	1.5 to 1.6	1.5 to 1.6	1.5 to 1.6
Automatic transmissionlitres	-	-	-	-
Final drivelitres	WT	WT	WT	WT
Cooling system.....litres	7.4	9.0	9.0	9.0
Fuel tank.....litres	60	70	70	70

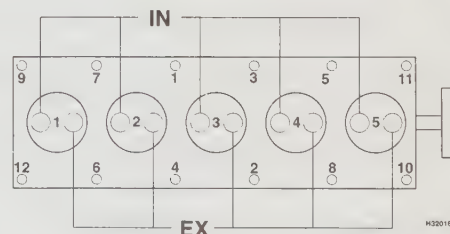
Notes

Croma 1.9 Turbo D 1988 to 1992

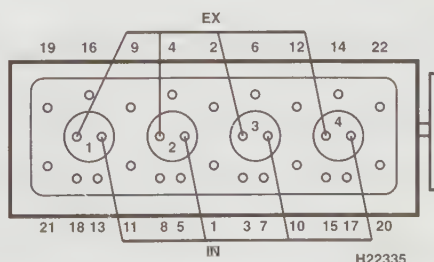
¹From chassis no. 290 838: 360



1929 cm³



2387 cm³



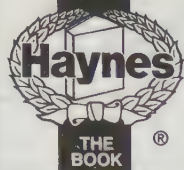
2499 cm³

- Not applicable, or information not available



FIAT

	Ulysse 1.9 TD S 1995 to 2000	Ulysse 1.9 TD S 1995 to 2000	Ulysse 2.1 TD S 1996 to 1999	Citivan & Duna 1.7 1988 to 1991
Engine				
Engine type/code.....	XUD9BTF DHX SOHC Turbo 66kW	XUD9BTF D8B SOHC Turbo 66kW	XUD11BTE P8C 12V Turbo 80kW	149 B3.000 OHC 44kW
Capacity (cm ³) / cylinders.....	1905 / 4	1905 / 4	2088 / 4	1697 / 4
Compression ratio / pressure.....bar	21.8 /	21.8 /	21.5 /	20.5 ± 0.5 / _
Torque output.....Nm	196	196	250	0
Oil pressure.....idle [running] bar	[5.0]	[5.0]	[5.0]	[3.4 to 4.9]
Oil temperature.....°C	80	80	80	100
Valve clearances - inlet (mm).....	0.15 ± 0.05	0.15 ± 0.05	0: Hyd.	0.30 ± 0.05
- exhaust (mm).....	0.30 ± 0.05	0.30 ± 0.05	0: Hyd.	0.30 ± 0.05
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature.....°C	83	83	83	80 ± 2
Radiator cap pressure.....bar	1.1	1.1	1.1	0.78
Fuel system				
Idle speed.....rpm	850 ± 20	850 ± 20	690 ± 30	760 ± 20
Maximum (no load) speed.....rpm	5070	5070	-	5150 ± 50
Smoke test/opacity.....M ⁻¹ %	1.85	1.85	1.85	1.65
Static timing method.....	Plunger travel	Plunger travel	Dial gauge	Plunger travel
Timing dimension.....mm	0.9 ± 0.05	0.9 ± 0.05	5.12	0.88
Crankshaft position.....mm [°]	TDC	TDC	[24] BTDC	[0] TDC
Turbo type / ref / pressure.....bar	KKK K14 / Garrett T2 0.8 bar	KKK K14 / Garrett T2 0.8 bar	-	-
Injection pump make.....	Bosch	Bosch	Lucas	Bosch
Injection pump part no.....	VER 513	VER 601	EPIC	-
Injector Make / type.....	Bosch	Bosch	-	Bosch
Injector part no.....	0432 217 218	0432 217 218	-	DNO SD 259
Injection type.....	ECU controlled	ECU controlled	Electronic control	VE R 256
Injection opening pressure, New [used]...bar	175	175	-	125 to 133
Glow plugs				
Maker.....	Bosch	Bosch	Bosch	Bosch/Marelli
Type.....	0250 201 033	0250 201 033	0250 201 033	0250 201 005 / UX2A
Nominal rating.....V/A	11 / 12	11 / 12	11 / 9	-
Brakes				
minimum friction material thickness				
Front.....mm	8.5 with backing	8.5 with backing	8.5 with backing	1.5
Rear.....mm	-	-	-	1.5
Tyres - Saloon / Hatch.....Size	-	-	-	165/70x13
- Estate / Van.....Size	205/65x15	205/65x15	205/65x15	165/70x13
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	2.2 / 1.9
- Estate / Van.....bar	2.3 / 2.3	2.3 / 2.3	2.3 / 2.3	2.2 / 1.9
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 ± 1.0	2.0 ± 1.0	2.0 ± 1.0	-3.0 ± 1.0
Camber.....	-1° ± 30'	-1° ± 30'	-1° ± 30'	1°45' ± 30' Est/van: 1°55'±30'
Castor.....	3° 30' ± 30'	3° 30' ± 30'	3° 30' ± 30'	1°5' ± 30' Est/van: 55'±30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 ± 1.0	2.0 ± 1.0	2.0 ± 1.0	5.0 ± 2.0
Camber.....	-1° ± 30'	-1° ± 30'	-1° ± 30'	-1°55' ± 30' Est/van: -1°20'



FIAT

	Ulysse 1.9 TD S 1995 to 2000	Ulysse 1.9 TD S 1995 to 2000	Ulysse 2.1 TD S 1996 to 1999	Citivan & Duna 1.7 1988 to 1991
Torque wrench settings				
Cylinder head - stage 1.....Nm	20 ¹	20 ¹	Bolt length: ≤146.5mm or...	50
- stage 2.....Nm	60	60	Pilot type: ≤150.5mm	100
- stage 3.....Nm	+ 220°	+ 220°	20	+ 90°
- stage 4.....Nm	-	-	60	+ 90°
- stage 5.....Nm	-	-	+ 180°	Bolts 11 to 15: 30
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	20 + 70° N	74 N
Main bearings.....Nm	70	70	15 + 60°	113
Crankshaft pulley bolt.....Nm	40 + 60°	40 + 60°	70 + 60°	180
Camshaft pulley bolt.....Nm	45	45	45	118
Flywheel [driveplate] bolt.....Nm	50	50	50	142
Front hubs.....Nm	110	110	110	216
Rear hubs.....Nm	100 + 60°	100 + 60°	100 + 60°	216
Wheel nuts / bolts.....Nm	100	100	100	86
Glow plugs.....Nm	18	18	18	15
Clutch pressure plate bolts.....Nm	20	20	20	16
Injection pump sprocket.....Nm	50	50	50	49
Injectors.....Nm	90	90	90	55
Injection pump mounting bolts.....Nm	20	20	20	25
Injector pipe unions.....Nm	25	25	25	24
Capacities				
Engine oil & filter.....litres	4.2	4.2	6.0	4.3
Gearbox.....litres	1.9	1.9	1.9	3.0
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	9.0	9.0	9.0	5.0
Fuel tank.....litres	80	80	80	54

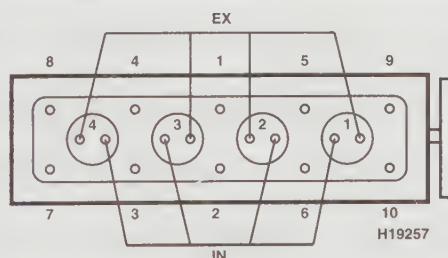
Notes

Ulysse 1.9 TD S 1995 to 2000

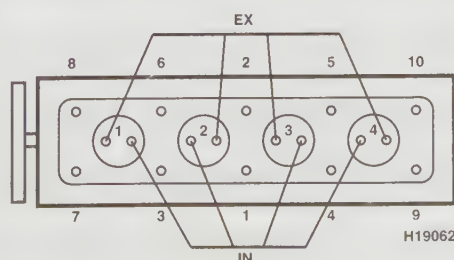
¹Bolt length below head ≤146.8 mm

Ulysse 1.9 TD S 1995 to 2000

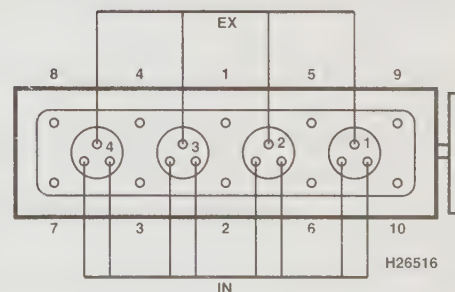
¹Bolt length below head ≤146.8 mm



1905 cm³



1697 cm³



2088 cm³

- Not applicable, or information not available



FIAT

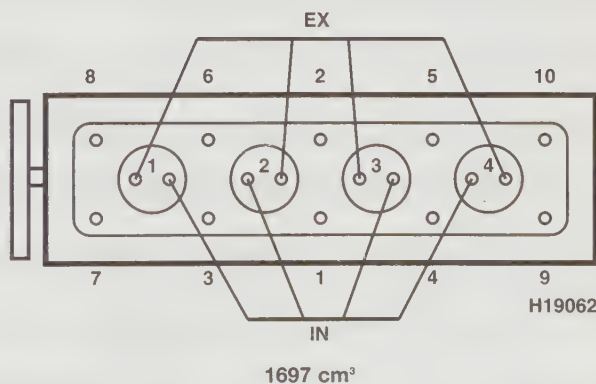
	Fiorino 1.7 1988 to 1991	Fiorino 1.7 1991 to 1993	Fiorino 1.7 1991 to 1993	Fiorino 1.7 1994 to 1997
Engine				
Engine type/code.....	149 B3.000 OHC 44kW	146 B2.000 OHC 42kW	146 B2.000 OHC 42kW	146 B2.000 OHC 42kW
Capacity (cm ³) / cylinders.....	1697 / 4	1697 / 4	1697 / 4	1697 / 4
Compression ratio / pressure.....bar	20.5 ± 0.5 / _	20.5 ± 0.5 / _	20.5 ± 0.5 / _	20.5 ± 0.5 / _
Torque outputNm	0	0	0	0
Oil pressureidle [running] bar	[3.4 to 4.9]	[3.4 to 4.9]	[3.4 to 4.9]	[3.4 to 4.9]
Oil temperature°C	100	100	100	100
Valve clearances - inlet (mm).....	0.30 ± 0.05	0.30 ± 0.05	0.30 ± 0.05	0.30 ± 0.05
- exhaust (mm).....	0.30 ± 0.05	0.35 ± 0.05	0.35 ± 0.05	0.35 ± 0.05
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	80 ± 2	80 ± 2	80 ± 2	80 ± 2
Radiator cap pressure.....bar	0.78	0.78	0.78	0.78
Fuel system				
Idle speedrpm	760 ± 20	760 ± 20	810 ± 20	900 ± 20
Maximum (no load) speedrpm	5150 ± 50	5150 ± 50	5150 ± 50	5150 ± 50
Smoke test/opacityM ⁻¹ %	1.65	1.65	1.74	1.74
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	0.88	1.0 ± 0.05	Dimension on pump	1.0 ± 0.05
Crankshaft positionmm [°]	[0] TDC	[0] TDC	[0] TDC	[0] TDC
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	Bosch	Bosch	CAV	Bosch
Injection pump part no.....	-	VER 308	DPC R8443	VER 463
Injector Make / type.....	Bosch	Bosch	CAV	Bosch
Injector part no.....	DNO SD 259	KCA 30S41	DNOSD6751C	0432 217 195
Injection type.....	VE R 256	Indirect VER	Indirect DPC	Indirect VER
Injection opening pressure, New [used]...bar	125 to 133	125 to 133	123	125 to 133
Glow plugs				
Maker.....	Bosch/Marelli	Bosch	Bosch	Bosch
Type.....	0250 201 005 / UX2A	0250 201 019	0250 201 019	0250 201 019
Nominal rating.....V/A	-	11 / 12	11 / 12	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.5	1.5	1.5
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	165/70x13	165/70x13	165/70x13	165/70x13
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Van.....bar	1.9 / 1.9	1.9 / 1.9	1.9 / 1.9	1.9 / 1.9
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-3.0 ± 1.0	-3.0 ± 1.0	-3.0 ± 1.0	-3.0 ± 1.0
Camber.....	1°50' ± 30'	1°50' ± 30'	1°50' ± 30'	1°50' ± 30'
Castor.....	30' ± 30' Pick-up: 25'±30'	30' ± 30' Pick-up: 25'±30'	30' ± 30' Pick-up: 25'±30'	30' ± 30' Pick-up: 25'±30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	5.0 ± 2.0	5.0 ± 2.0	5.0 ± 2.0	5.0 ± 2.0
Camber.....	-1° ± 30' Pick-up: -40'±30'	-1° ± 30' Pick-up: -40'±30'	-1° ± 30' Pick-up: -40'±30'	-1° ± 30' Pick-up: -40'±30'



FIAT

	Fiorino 1.7 1988 to 1991	Fiorino 1.7 1991 to 1993	Fiorino 1.7 1991 to 1993	Fiorino 1.7 1994 to 1997
Torque wrench settings				
Cylinder head - stage 1.....Nm	50	50	50	50
- stage 2.....Nm	100	100	100	100
- stage 3.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5.....Nm	Bolts 11 to 15: 30	Bolts 11 to 15: 30	Bolts 11 to 15: 30	Bolts 11 to 15: 30
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	74 N	74 N	74 N	74 N
Main bearings.....Nm	113	113	113	113
Crankshaft pulley bolt.....Nm	180	180	180	180
Camshaft pulley bolt.....Nm	118	118	118	118
Flywheel [driveplate] bolt.....Nm	142	142	142	142
Front hubs.....Nm	216	294	294	240
Rear hubs.....Nm	216	216	216	280
Wheel nuts / bolts.....Nm	86	86	86	86
Glow plugs.....Nm	15	15	15	15
Clutch pressure plate bolts.....Nm	16	16	16	16
Injection pump sprocket.....Nm	49	49	49	49
Injectors.....Nm	55	55	55	55
Injection pump mounting bolts.....Nm	25	25	25	25
Injector pipe unions.....Nm	24	24	24	24
Capacities				
Engine oil & filter.....litres	4.3	4.3	4.3	4.6
Gearbox.....litres	3.0	3.0	3.0	3.0
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	5.0	5.0	5.0	5.0
Fuel tank.....litres	54	54	54	54

Notes



- Not applicable, or information not available



FIAT

	Fiorino 1.7 1994 to 1997	Fiorino 1.7 TD 1997 to 1999	Scudo 1.9 D 1999 to 2000	Scudo 1.9 D 1996 to 1999
Engine				
Engine type/code	146 B2.000 OHC 42kW	146 D7.000 SOHC Turbo 46kW	DW8 WJZ SOHC 51kW	XUD9 D9B SOHC 51kW
Capacity (cm ³) / cylinders	1697 / 4	1697 / 4	1868 / 4	1905 / 4
Compression ration / pressure	20.5 ± 0.5 / _	20.3 /	23.0 /	23 / _
Torque output	0	118	125	120
Oil pressure	[3.4 to 4.9]	[3.4]	[5.0 @ 4000]	0.8 [3.4 to 4.9 @ 4000]
Oil temperature	100	100	80	80
Valve clearances - inlet (mm)	0.30 ± 0.05	0.30 ± 0.05	0.15 ± 0.05	0.15 ± 0.05
- exhaust (mm)	0.35 ± 0.05	0.35 ± 0.05	0.30 ± 0.05	0.30 ± 0.08
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	-	FE	FE
Cooling system				
Thermostat opening temperature	80 ± 2	78	83	87 to 98
Radiator cap pressure	0.78	0.8	1.1	1.0
Fuel system				
Idle speed	810 ± 20	900 ± 50	750 to 800	750 to 800
Maximum (no load) speed	5150 ± 50	4950 ± 50	5300 ± 50	5250 to 5350
Smoke test/opacity	1.74	1.8	2.5	1.48
Static timing method	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension	Dimension on pump	1.0	0.9	0.9 ± 0.05
Crankshaft position	[0] TDC	TDC	TDC	TDC
Turbo type / ref / pressure	-	Garrett T2 0.75 bar	-	-
Injection pump make	CAV	Lucas	Bosch	Bosch
Injection pump part no.	R8444 B300A	FT11 8445	VER 425-10/11	VER 425-6
Injector Make / type	CAV	-	-	Bosch
Injector part no.	LRC 67326	Lucas RDNO 6888D	DNOSD 299A	0432 217 248
Injection type	Indirect DPC	Indirect	Indirect VER	Indirect VER
Injection opening pressure, New [used]...bar	124 to 131 [116]	143 to 150	-	130
Glow plugs				
Maker	Bosch	Bosch	-	Bosch/Champion
Type	0250 201 019	0250 201 005	-	0250 201 039 / CH1693
Nominal rating	11 / 12	11 / 18	-	11 / 9
Brakes				
minimum friction material thickness				
Front	1.5	1.5	1.5	1.5
Rear	1.5	1.5	1.5	1.0
Tyres - Saloon / Hatch				
- Estate / Van	165/70x13	165/70x13	195/70x14	195/70x14
Pressure - front / rear - Saloon / Hatch ...bar	-	-	-	-
- Estate / Van	1.9 / 1.9	2.2 / 1.9	3.0 / 3.0	2.5 / 2.5
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-)	-3.0 ± 1.0	-3.0 ± 1.0	1.0 ± 0.5	2.0 ± 1.0
Camber	1°50' ± 30'	-0°15' ± 20'	0° ± 30'	0° ± 30'
Castor	30' ± 30' Pick-up: 25' ± 30'	0°40' ± 20°1'	3°30' ± 30'	1° ± 30' PAS: 3°30' ± 30'
King pin inclination	-	-	11°28' ± 40'	11°28' ± 40'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-)	5.0 ± 2.0	0	2.0 ± 1.0	2.0 ± 1.0
Camber	-1° ± 30' Pick-up: -40' ± 30'	-	-1° ± 30'	-1° ± 30'

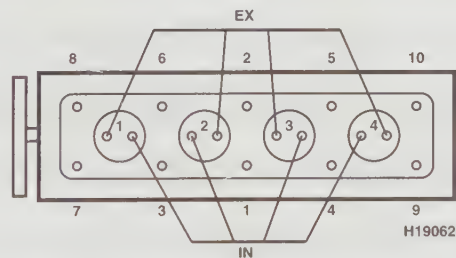


FIAT

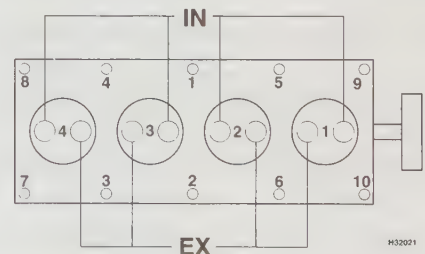
	Fiorino 1.7 1994 to 1997	Fiorino 1.7 TD 1997 to 1999	Scudo 1.9 D 1999 to 2000	Scudo 1.9 D 1996 to 1999
Torque wrench settings				
Cylinder head - stage 1	50	50 N	20	20 N
- stage 2	100	100	60	60
- stage 3	+ 90°	+ 90°	+ 180°	+ 90°
- stage 4	+ 90°	+ 90°	-	+ 90°
- stage 5	Bolts 11 to 15: 30	-	-	-
- stage 6	-	-	-	-
Big-end bearings	74 N	20 + 50° N	20 + 70° N	20 + 70° N
Main bearings	113	113	70	15 + 60°
Crankshaft pulley bolt	180	190	-	40 + 60°
Camshaft pulley bolt	118	118	-	45
Flywheel [driveplate] bolt	142	142	48	50
Front hubs	240	240	100 + 60°	100 + 60° oiled
Rear hubs	280	280	100 ± 60°	100 + 60°
Wheel nuts / bolts	86	86	100	100
Glow plugs	15	15	-	20
Clutch pressure plate bolts	16	18	20	23
Injection pump sprocket	49	49	-	50
Injectors	55	55	-	90
Injection pump mounting bolts	25	25	-	20
Injector pipe unions	24	24	-	-
Capacities				
Engine oil & filter	4.6	4.6	5.0	5.0
Gearbox	3.0	3.1	1.9	1.8
Automatic transmission	-	-	-	-
Final drive	WT	WT	WT	WT
Cooling system	5.0	5.0	8.5	8.5
Fuel tank	54	64	80	80

Notes

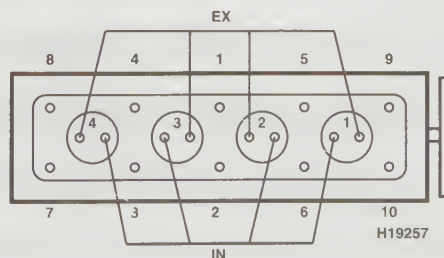
Fiorino 1.7 TD 1997 to 1999
 'Pick-up: 2° ± 20'



1697 cm³ / 1698 cm³



1868 cm³



1905 cm³

- Not applicable, or information not available



FIAT

	Scudo 1.9 TD 1996 to 1999	Ducato 1.9 D 1987 to 1993	Ducato 1930 Turbo D 1986 to 1993	Ducato 1.9 DS 1994 to 1998
Engine				
Engine type/code	XUD9BTF DHX Turbo 68kW	149 B1.000 SOHC 52kW	280 A1.000 SOHC Turbo 60kW	230 A2.000 SOHC 51kW
Capacity (cm ³) / cylinders	1905 / 4	1929 / 4	1929 / 4	1929 / 4
Compression ratio / pressure	21.8 / _	21.5 ± 0.5 / _	20.0 ± 0.5 / _	21.0 /
Torque output	196	0	0	0
Oil pressureidle [running] bar	0.8 [3.4 to 4.9]	[3.4 to 4.9]	[3.4 to 4.9]	[3.5 to 5.5]
Oil temperature°C	80	100	100	100
Valve clearances - inlet (mm)	0.15 ± 0.05	0.30 ± 0.05	0.30 ± 0.05	0.30 ± 0.05
- exhaust (mm)	0.30 ± 0.05	0.35 ± 0.05	0.35 ± 0.05	0.35 ± 0.05
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	F	F	-
Cooling system				
Thermostat opening temperature°C	87 to 98	78 to 82	78 to 82	-
Radiator cap pressure	1.0	0.78	0.78	-
Fuel system				
Idle speedrpm	825 ± 25	740 to 780	780 ± 20	900 ± 20
Maximum (no load) speedrpm	5070 to 5230	5100 to 5200	4900 ± 40	5200
Smoke test/opacityM ⁻¹ %	2.5	1.84	2.0	1.68
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	0.9	1.0	1.0	0.86 ± 0.05
Crankshaft positionmm [°]	TDC	0 TDC	0 TDC	TDC
Turbo type / ref / pressure	KKK K14 or Garrett T2*	-	0.8 bar	-
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VER 513	0460 494 214	VE4/9	VE R549
Injector Make / type	Bosch	Bosch	Bosch	Bosch
Injector part no.....	DNOSD 299	0432 217 129	0432 217 172	0432 217 195
Injection type.....	Indirect VER	VER	VE 4/9F 2100L184	Indirect VE
Injection opening pressure, New [used]...bar	175	125 to 133	150 to 158	130 to 133
Glow plugs				
Maker	Beru	Bosch	Bosch	Bosch/Champion
Type	GN909	0250 201 005	0250 201 005	0250 201 005 / CH68
Nominal rating.....V/A	11 / 12	11 / 12	11 / 12	-
Brakes				
minimum friction material thickness				
Front.....mm	1.5	2.0	2.0	1.0
Rear.....mm	1.0	1.0	1.0	1.5
Tyres - Saloon / Hatch.....Size	-	-	-	-
- Estate / Van.....Size	195/70x14	185x14	185x14	195/75x15
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	2.5 / 2.5	3.5 / 3.2	3.5 / 3.2	Refer to vehicle
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 ± 1.0	0.5 to 2.5	0.5 to 2.5	-2.0 ± 1.0
Camber	0° ± 30'	1°30' to 2°30'	1°30' to 2°30'	0° ± 30'
Castor	1° ± 30' PAS: 3°30' ± 30'	0° to 1°	08 to 1°	1° ± 30'
King pin inclination.....	11°28' ± 40'	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 ± 1.0	-	-	0 ± 1.0
Camber	-1° ± 30'	-	-	0° ± 10'



FIAT

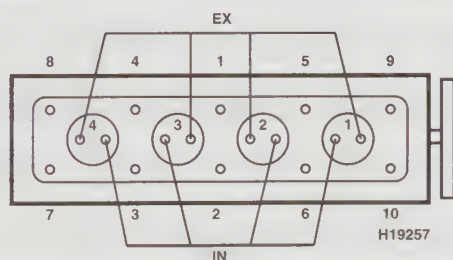
	Scudo 1.9 TD 1996 to 1999	Ducato 1.9 D 1987 to 1993	Ducato 1930 Turbo D 1986 to 1993	Ducato 1.9 DS 1994 to 1998
Torque wrench settings				
Cylinder head - stage 1Nm	20 ¹	50	50	20
- stage 2Nm	60	100	100	30
- stage 3Nm	+ 220°	+ 90°	+ 90°	+ 180°
- stage 4Nm	-	+ 90°	+ 90°	+ 90°
- stage 5Nm	-	Bolts 11 to 15: 30	Bolts 11 to 15: 30	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	20 + 70° N	25 + 50° N	25 + 50° N	25 + 50° N
Main bearings.....Nm	70	113	113	113
Crankshaft pulley boltNm	40 + 60°	190	190	190
Camshaft pulley boltNm	45	118	118	118
Flywheel [driveplate] bolt.....Nm	50	142	142	142
Front hubsNm	100 + 60° oiled	421 to 510	421 to 510	450
Rear hubsNm	100 + 60°	WSM	WSM	WSM
Wheel nuts / boltsNm	100	160	160	160
Glow plugsNm	22	15	15	15
Clutch pressure plate boltsNm	23	15	15	-
Injection pump sprocket.....Nm	50	49	49	49
Injectors.....Nm	90	55	55	80
Injection pump mounting boltsNm	22	25	25	25
Injector pipe unions.....Nm	20	24	24	30
Capacities				
Engine oil & filter.....litres	5.0	5.0	5.0	5.0
Gearbox.....litres	1.8	1.25 89►: 1.6	1.25 89►: 1.6	2.0
Automatic transmissionlitres	-	-	-	-
Final drivelitres	WT	WT	WT	WT
Cooling system.....litres	8.5	9.0	9.0	-
Fuel tank.....litres	80	70	70	80

Notes

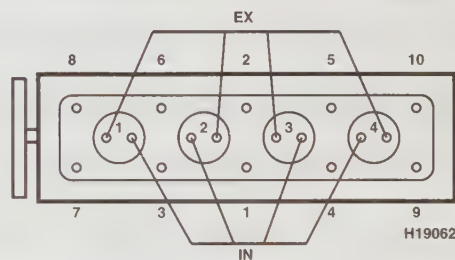
Scudo 1.9 TD 1996 to 1999

¹Bolt length below head: ≤121.5mm

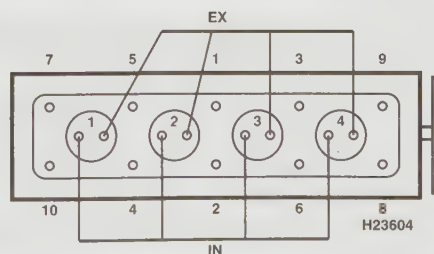
²0.67 to 0.76 bar @ 2000rpm



1905 cm³



1929 cm³



1929 cm³

- Not applicable, or information not available



FIAT

	Ducato 1.9 TDS 1994 to 1998	Ducato 1.9 TD 1999 to 2000	Ducato 2500 Turbo D & 4x4 1990 to 1994	Ducato 2500 D & 4x4 1986 to 1994
Engine				
Engine type/code.....	230 A3.000 SOHC Turbo 60kW	XUD9BTF DHX SOHC Turbo 66kW	8140.27 SOHC Turbo 70kW	8144.67 SOHC 55kW
Capacity (cm ³) / cylinders.....	1929 / 4	1905 / 4	2445 / 4	2499 / 4
Compression ratio / pressure.....bar	21.0 /	21.8 /	18.0 /	22.0 /
Torque output.....Nm	180	196	0	0
Oil pressure.....idle [running] bar	[3.5 to 5.5]	0.8 [3.4 to 3.9]	0.78 [3.9 @ 4000]	0.78 [3.9]
Oil temperature.....°C	100	80	100	100
Valve clearances - inlet (mm).....	0.30 ± 0.05	0.15 ± 0.05	0.50	0.50
- exhaust (mm).....	0.35 ± 0.05	0.30 ± 0.05	0.50	0.50
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	-	FE	FE	FE
Cooling system				
Thermostat opening temperature.....°C	-	87 to 98	72 to 76	77 to 81
Radiator cap pressure.....bar	-	1.0	0.78	0.78
Fuel system				
Idle speed.....rpm	900 ± 20	825 ± 25	740 to 780	740 to 780
Maximum (no load) speed.....rpm	5200	5070 to 5230	4475 ± 50	4600 to 4900
Smoke test/opacity.....M ⁻¹ %	1.61	2.5	2.0	2.0
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	0.8 ± 0.05	0.9	1.48 ± 0.04	1.0 ± 0.04
Crankshaft position.....mm [°]	TDC	TDC	0 TDC	0 TDC
Turbo type / ref / pressure.....bar	0.8 bar @ 4200	-	-	-
Injection pump make.....	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VE R545	VER 513	0460 414 081	0460 494 189
Injector Make / type.....	Bosch	Bosch	Bosch	Bosch
Injector part no.....	0432 217 195	DNOSD299	0432 191 760	0432 297 034
Injection type.....	Indirect VE	Indirect VER	Direct VER 127	VER 22/7
Injection opening pressure, New [used]...bar	130 to 133	175	222 to 238	120 to 130
Glow plugs				
Maker.....	Bosch/Champion	Beru	Bosch	Bosch
Type.....	0250 201 033 / CH68	GN909	0250 201 006	0250 201 006
Nominal rating.....V/A	-	11 / 12	11 / 12	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	1.0	1.0	2.0	2.0
Rear.....mm	1.5	1.5	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/75x15	195/75x15	185x14: 195/75x16	185x14: 195/75x16
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Van.....bar	Refer to vehicle	Refer to vehicle	Refer to vehicle	Refer to vehicle
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-2.0 ± 1.0	-2.0 ± 1.0	0.5 to 2.5'	0.5 to 2.5'
Camber.....	0° ± 30'	0° ± 30'	1°30' to 2°30'²	1°30' to 2°30'²
Castor.....	1° ± 30'	1° ± 30'	0° to 1° 18: 0° to 30'	0° to 1° 18: 0° to 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 1.0	0 ± 1.0	-	-
Camber.....	0° ± 10'	0° ± 10'	-	-



FIAT

	Ducato 1.9 TDS 1994 to 1998	Ducato 1.9 TD 1999 to 2000	Ducato 2500 Turbo D & 4x4 1990 to 1994	Ducato 2500 D & 4x4 1986 to 1994
Torque wrench settings				
Cylinder head - stage 1.....Nm	20	20*	40	40
- stage 2.....Nm	30	60	Slacken, 40	Slacken, 40
- stage 3.....Nm	+ 180°	+ 220°	+ 180°	+ 180°
- stage 4.....Nm	+ 90°	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	25 + 50° N	20 + 70° N	110 N	115 N
Main bearings.....Nm	113	70	160	160
Crankshaft pulley bolt.....Nm	190	40 + 60°	205	190
Camshaft pulley bolt.....Nm	118	45	25	25
Flywheel [driveplate] bolt.....Nm	142	50	125	125
Front hubs.....Nm	450	450	421 to 510	421 to 510
Rear hubs.....Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	160	160	160	160
Glow plugs.....Nm	15	22	23	23
Clutch pressure plate bolts.....Nm	-	23	15	15
Injection pump sprocket.....Nm	49	50	60	25
Injectors.....Nm	80	90	35	95
Injection pump mounting bolts.....Nm	25	22	-	25
Injector pipe unions.....Nm	30	20	-	-
Capacities				
Engine oil & filter.....litres	5.0	5.0	6.4	5.5
Gearbox.....litres	2.0	2.0	1.25 89 ►: 1.6	1.25 89 ►: 1.6
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	-	8.5	9.0	9.0
Fuel tank.....litres	80	80	70	70

Notes

Ducato 1.9 TD 1999 to 2000

*Bolt length below head: ≤121.5 mm

Ducato 2500 Turbo D & 4x4 1990 to 1994

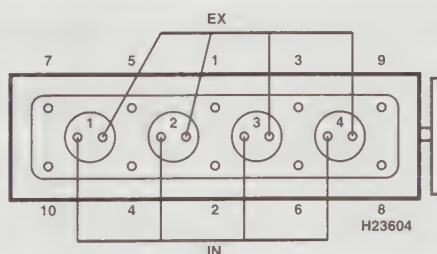
*Ducato 18: -1.0 to 1.0

*Ducato 18: 2° to 2°30'

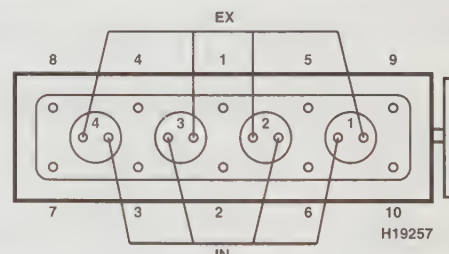
Ducato 2500 D & 4x4 1986 to 1994

*Ducato 18: -1.0 to 1.0

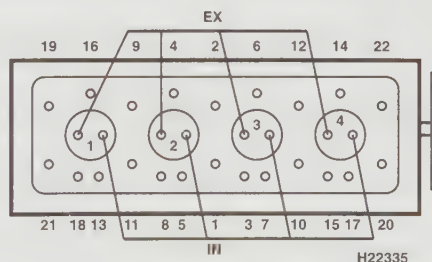
*Ducato 18: 2° to 2°30'



1929 cm³



1905 cm³



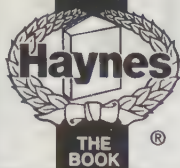
2445 cm³ / 2499 cm³

- Not applicable, or information not available



FIAT

	Ducato 2500 D (CRD) 1987 to 1994	Ducato 2.5 D 1994 to 1999	Ducato 2.5 TD 1994 to 1999	Ducato 2.8 D 1998 to 2000
Engine				
Engine type/code.....	U25/661 OHV 54kW	8140.67 SOHC 62kW	8140.47 SOHC Turbo 85kW	8140.67 SOHC 64kW
Capacity (cm ³) / cylinders.....	2500 / 4	2499 / 4	2499 / 4	2800 / 4
Compression ratio / pressure.....bar	22.25 / _	22.5 /	18.5 /	21.7 /
Torque outputNm	0	164	245	180
Oil pressureidle [running] bar	[3.7 to 4.5 @ 3500]	0.8	0.8	0.8
Oil temperature°C	100	100	100	100
Valve clearances - inlet (mm).....	0.30	0.50	0.50	0.50
- exhaust (mm).....	0.20	0.50	0.50	0.50
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	-	-	TBE
Cooling system				
Thermostat opening temperature°C	75 to 78	81	81	82
Radiator cap pressure.....bar	1.0	1.0	1.0	1.0
Fuel system				
Idle speedrpm	775 to 825	775 ± 25	750 ± 25	775 ± 25
Maximum (no load) speedrpm	4625 ± 25	4750 ± 50	4450 ± 50	4750 ± 50
Smoke test/opacityM ⁻¹ %	2.5	1.85	1.85	2.5
Static timing method.....	Refer to wsm	Plunger travel	Rotor lift	Rotor lift
Timing dimension.....mm	-	1.0 ± 0.03	1.31 ± 0.03	1.15 ± 0.05
Crankshaft positionmm [°]	4.32 [22]	TDC	TDC	TDC
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	Roto Diesel	Bosch	Bosch	Bosch
Injection pump part no.....	R3449 F 010	VER 518	VER 542	R735
Injector Make / type.....	Roto Diesel	Bosch	Bosch	-
Injector part no.....	RDNOSDC 6577	-	-	DSLA 134P 604
Injection type.....	MA300	Indirect VER	Direct	Direct injection
Injection opening pressure, New [used]...bar	112 to 117 [112]	120 to 128	240 to 248	240 to 252
Glow plugs				
Maker.....	Beru	Beru	Beru	-
Type.....	0100 221 106	GN908	GN927	-
Nominal rating.....V/A	11 / 12	-	-	-
Brakes				
minimum friction material thickness				
Front.....mm	2.0	1.0	1.0	4.0
Rear.....mm	1.0	1.5	1.5	1.0
Tyres - Saloon / Hatch.....Size	-	-	-	-
- Estate / Van.....Size	185x14	195/70x15: 205/75x16	195/70x15: 205/75x16	214/70x15
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Van.....bar	Refer to vehicle	Refer to vehicle	Refer to vehicle	5.0 / 5.0
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.5 to 2.5	-2.0 ± 1.0	-2.0 ± 1.0	2.0 ± 1.0
Camber.....	1°30' to 2°30'	0° ± 30'	0° ± 30'	0° ± 30'
Castor.....	0° to 1°	1° ± 30'	1° ± 30'	1° ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	0 ± 1.0	0 ± 1.0	0.0 ± 1.0
Camber.....	-	0° ± 10'	0° ± 10'	0° ± 10'



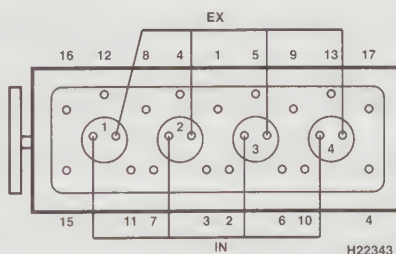
FIAT

	Ducato 2500 D (CRD) 1987 to 1994	Ducato 2.5 D 1994 to 1999	Ducato 2.5 TD 1994 to 1999	Ducato 2.8 D 1998 to 2000
Torque wrench settings				
Cylinder head - stage 1.....Nm	40	60	60	60 N
- stage 2.....Nm	+ 100°	+ 180°	+ 180°	+ 180°
- stage 3.....Nm	+ 100°	-	-	-
- stage 4.....Nm	warm up, allow to cool	-	-	-
- stage 5.....Nm	+ 45°	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	72 to 90 N	118 N	118 N	118 N
Main bearings.....Nm	95	160	160	WSM
Crankshaft pulley bolt.....Nm	-	200	200	-
Camshaft pulley bolt.....Nm	32	-	-	-
Flywheel [driveplate] bolt.....Nm	90 LkC	125	125	30 + 90°
Front hubs.....Nm	421 to 510	450	450	450
Rear hubs.....Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	160	160 Maxi: 180	160 Maxi: 180	160
Glow plugs.....Nm	28	25	25	-
Clutch pressure plate bolts.....Nm	15	25	25	25
Injection pump sprocket.....Nm	23	95	95	-
Injectors.....Nm	24	50	50	-
Injection pump mounting bolts.....Nm	30	-	-	-
Injector pipe unions.....Nm	24	25	25	-
Capacities				
Engine oil & filter.....litres	4.7 ¹	7.3	7.3	6.7
Gearbox.....litres	1.25 89 ▶: 1.6	2.0 Maxi 2.45	2.0 Maxi 2.45	2.75
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	10.6	11.0	10.0	10.0
Fuel tank.....litres	70	80	80	80

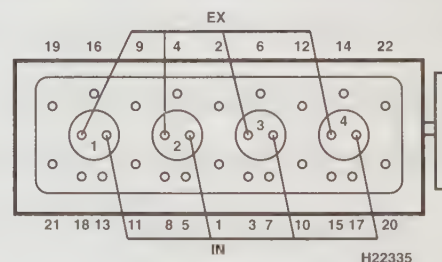
Notes

Ducato 2500 D (CRD) 1987 to 1994

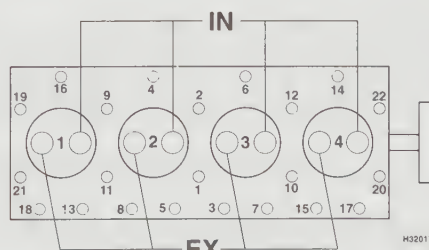
¹Engine no. GJ 06061862 ▶: 5.6



2500 cm³



2499 cm³



2800 cm³

- Not applicable, or information not available



FIAT

	Ducato 2.8 TD 1998 to 2000			
Engine				
Engine type/code	8140.43 SOHC Turbo 90kW			
Capacity (cm ³) / cylinders	2800 / 4			
Compression ratio / pressure	19.0 /			
Torque output	283			
Oil pressureidle [running] bar	0.8			
Oil temperature°C	100			
Valve clearances - inlet (mm)	0.50			
- exhaust (mm)	0.50			
Injection order	1-3-4-2			
No. 1 cylinder position	-			
Cooling system				
Thermostat opening temperature°C	82			
Radiator cap pressure	1.0			
Fuel system				
Idle speedrpm	750 ± 25			
Maximum (no load) speedrpm	4450 ± 50			
Smoke test/opacityM ⁻¹ %	2.5			
Static timing method	Rotor lift			
Timing dimension.....mm	1.1 ± 0.05			
Crankshaft positionmm [°]	TDC			
Turbo type / ref / pressure	KKK K14 ot Mitsubishi TFO 35 M			
Injection pump make	Bosch			
Injection pump part no.....	R799			
Injector Make / type	Bosch			
Injector part no.....	DSLA 141P 405			
Injection type.....	Direct			
Injection opening pressure, New [used]...bar	240 to 248			
Glow plugs				
Maker	-			
Type	-			
Nominal rating.....V/A	-			
Brakes				
minimum friction material thickness				
Front.....mm	4.0			
Rear.....mm	1.0			
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	215/70x15			
Pressure - front / rear - Saloon / Hatch...bar	-			
- Estate / Vanbar	5.0 / 5.0			
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 ± 1.0			
Camber	0° ± 30'			
Castor	1° ± 30'			
King pin inclination.....	-			
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.0 ± 1.0			
Camber	0° ± 10'			



FIAT

Ducato 2.8 TD
1998 to 2000

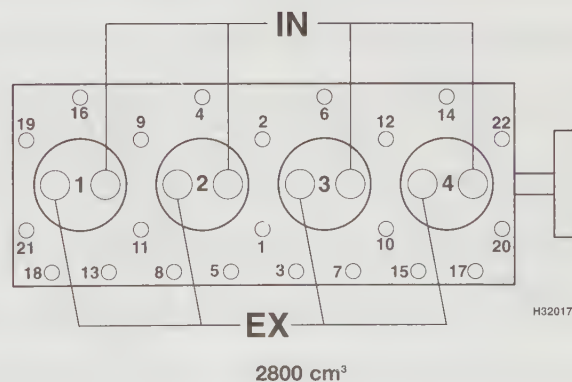
Torque wrench settings

Cylinder head - stage 1	Nm	60 N
- stage 2	Nm	+ 180°
- stage 3	Nm	-
- stage 4	Nm	-
- stage 5	Nm	-
- stage 6	Nm	-
Big-end bearings	Nm	118 N
Main bearings	Nm	WSM
Crankshaft pulley bolt	Nm	-
Camshaft pulley bolt	Nm	-
Flywheel [driveplate] bolt	Nm	30 + 90°
Front hubs	Nm	450
Rear hubs	Nm	-
Wheel nuts / bolts	Nm	160
Glow plugs	Nm	-
Clutch pressure plate bolts	Nm	25
Injection pump sprocket	Nm	-
Injectors	Nm	-
Injection pump mounting bolts	Nm	-
Injector pipe unions	Nm	-

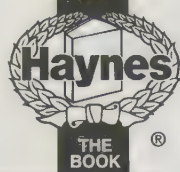
Capacities

Engine oil & filter	litres	6.7
Gearbox	litres	2.75
Automatic transmission	litres	-
Final drive	litres	WT
Cooling system	litres	10.0
Fuel tank	litres	80

Notes



- Not applicable, or information not available



FORD

	Fiesta 1.8 & Van 1989 to 1996	Fiesta 1.8 & Van 1989 to 1996	Fiesta 1.8 1995 to 1999	Escort & Orion 1.8 TD 1995 to 1997
Engine				
Engine type/code	RTC/RTD SOHC 44kW	RTC/RTD SOHC 44kW	Endura-DE RTJ ⁴ SOHC 43kW	RVA Endura-DE SOHC ¹ 51kW
Capacity (cm ³) / cylinders	1753 / 4	1753 / 4	1753 / 4	1753 / 4
Compression ratio / pressure	21.5 / 28 to 34	21.5 / 28 to 34	21.5 / 28.0 to 34.0	21.5 / 28.0 to 34.0
Torque output	110	110	105	135
Oil pressureidle [running] bar	0.75 [1.5]	0.75 [1.5]	0.75 [1.5]	0.75 [1.5]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.30 to 0.40	0.30 to 0.40	0.30 to 0.40	0.35 ± 0.05
- exhaust (mm)	0.45 to 0.55	0.45 to 0.55	0.45 to 0.55	0.50 ± 0.05
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	85 to 89	85 to 89	85 to 89	85 to 89
Radiator cap pressure	1.0 to 1.3	1.0 to 1.3	1.2	1.2
Fuel system				
Idle speedrpm	850 ± 50	850 ± 50	920 ± 50	850 ± 50
Maximum (no load) speedrpm	5350 ± 50	5350 ± 50	5350 ± 50	5150 ± 50
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Refer to wsm	Refer to wsm	Refer to wsm	Refer to wsm
Timing dimension.....mm	-	-	-	-
Crankshaft positionmm [°]	-	-	-	-
Turbo type / ref / pressure	-	-	-	-
Injection pump make	CAV	Bosch	Bosch	Lucas
Injection pump part no.....	-	-	VE	DPC
Injector Make / type.....	Pintle	Pintle	Bosch	CAV
Injector part no.....	-	-	-	Pintle
Injection type.....	Indirect	Indirect	Indirect	EEC V
Injection opening pressure, New [used]...bar	120 ± 6	143 ± 7	158 to 165	120
Glow plugs				
Maker	Champion	Champion	Bosch/Champion	Motorcraft
Type	CH147	CH147	0250 202 001 / CH147	EZD34
Nominal rating.....V/A	11.5 / 16	11.5 / 16	-	11.5 / 16
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.5	1.5	1.5
Rear.....mm	1.0	1.0	1.5	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	145x13	145x13	165/70x13	155x13: 175/70x13: 185/60x14
Pressure - front / rear - Saloon / Hatch...bar	2.0 / 1.8'	2.0 / 1.8'	2.1 / 1.8	2.0 / 1.8
- Estate / Vanbar	2.0 / 1.8	2.0 / 1.8	2.1 / 1.8	2.0 / 1.8
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-3.0 to 3.0°	-3.0 to 3.0°	0 ± 1.0	2.0 ± 1.0
Camber	12' ± 1°15' ¹³	12' ± 1°15' ¹³	-40' ± 1°10' ¹²	-19' ± 14'
Castor	18' ± 1° ¹⁴	18' ± 1° ¹⁴	1°20' ± 1°15' ¹³	1°12' ± 1°20'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.3 ± 2.0	2.3 ± 2.0	2.5 ± 2.0	2.0 ± 2.0
Camber	-1° +30' -1°	-1° +30' -1°	-1° ± 70'	-1° ± 50'



FORD

	Fiesta 1.8 & Van 1989 to 1996	Fiesta 1.8 & Van 1989 to 1996	Fiesta 1.8 1995 to 1999	Escort & Orion 1.8 TD 1995 to 1997
Torque wrench settings				
Cylinder head - stage 1.....Nm	20 to 30	20 to 30	10 N	10 N
- stage 2.....Nm	76 to 92	76 to 92	100	100
- stage 3.....Nm	Wait 2 min.	Wait 2 min.	- 180°	Wait 3 min.
- stage 4.....Nm	+ 90°	+ 90°	70	- 180°
- stage 5.....Nm	Bolts must not be retorqued	Bolts must not be retorqued	+ 120°	70
- stage 6.....Nm	-	-	-	+ 120°
Big-end bearings.....Nm	20 to 30 ⁶ N	20 to 30 ⁶ N	25 + 60° + 20° N	30 + 60° + 20° N
Main bearings.....Nm	27 + 45°	27 + 45°	25 + 75°	27 + 75°
Crankshaft pulley bolt.....Nm	180	180	150, slacken, 120 + 60°	150, slacken, 120 + 60°
Camshaft pulley bolt.....Nm	M6: 9 to 11 ⁶	M6: 9 to 11 ⁶	23	11 M8: 33
Flywheel [driveplate] bolt.....Nm	15 to 20 ⁷	15 to 20 ⁷	18 + 45° + 45°	20 + 35° + 35°
Front hubs.....Nm	205 to 235	205 to 235	270	220 M22: 235
Rear hubs.....Nm	250 to 290	250 to 290	270	260
Wheel nuts / bolts.....Nm	100	100	85	100
Glow plugs.....Nm	25 to 30	25 to 30	28	30
Clutch pressure plate bolts.....Nm	25 to 34	25 to 34	30	30
Injection pump sprocket.....Nm	20 to 25	20 to 25	23	25
Injectors.....Nm	60 to 80	60 to 80	70	60 to 80
Injection pump mounting bolts.....Nm	18 to 22	18 to 22	24	25
Injector pipe unions.....Nm	15 to 25	15 to 25	25	25
Capacities				
Engine oil & filter.....litres	4.5	4.5	5.0	4.5
Gearbox.....litres	3.1	3.1	2.6	2.8
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	8.6	8.6	9.3	9.3
Fuel tank.....litres	42	42	42	55
Notes Fiesta 1.8 & Van 1989 to 1996 ¹ 155/70x13: 2.2 / 1.8 ² 90 ▶: -4.5 to +0.5 ³ 90 ▶: -8'±1°20', Van: -3'±1°20' ⁴ 90 ▶: 53'±1°15', Van: 51'±1°15' ⁵ + 60° + 20° ⁶ M8: 27 to 33 ⁷ + 45+0-10° + 45+0-10° Fiesta 1.8 & Van 1989 to 1996 ¹ 155/70x13: 2.2 / 1.8 ² 90 ▶: -4.5 to +0.5 ³ 90 ▶: -8'±1°20', Van: -3'±1°20' ⁴ 90 ▶: +53'±1°15', Van: +51'±1°15' ⁵ + 60° + 20° ⁶ M8: 27 to 33 ⁷ + 45+0-10° + 45+0-10° Fiesta 1.8 1995 to 1999 ¹ Van: 0°44' -2' +4' ² Van: 2°33' ³ or RTK Escort & Orion 1.8 TD 1995 to 1997 ¹ Turbo				
<p style="text-align: center;">1753 cm³</p>				
- Not applicable, or information not available				



FORD

	Escort & Orion 1.8 TD 1995 to 1999	Escort & Orion 1.8 TDi 1993 to 1999	Escort & Orion 1.8 1990 to 1998	Escort & Orion 1.8 1990 to 1998
Engine				
Engine type/code	RVA Endura-DE SOHC ³ 51kW	RFD/RFK Endura-DE ¹ 66kW	RTE SOHC 44kW	RTE/RTF/RTH SOHC 44kW ¹
Capacity (cm ³) / cylinders	1753 / 4	1753 / 4	1753 / 4	1753 / 4
Compression ratio / pressure	21.5 / 28.0 to 34.0	21.5 / 28.0 to 34.0	21.5 / 28 to 34	21.5 / 28 to 34
Torque output	135	180	110	110
Oil pressureidle [running] bar	0.75 [1.5]	0.75 [1.5]	0.75 [1.5]	0.75 [1.5]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.35 ± 0.05	0.35 ± 0.05	0.30 to 0.40	0.30 to 0.40
- exhaust (mm)	0.50 ± 0.05	0.50 ± 0.05	0.45 to 0.55	0.45 to 0.55
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	85 to 89	85 to 89	85 to 89	85 to 89
Radiator cap pressure	1.2	1.2	1.2	1.2
Fuel system				
Idle speedrpm	850 ± 50	850 ± 50	850 ± 50	850 ± 50
Maximum (no load) speedrpm	5150 ± 50	5150 ± 50	5350 ± 50	5350 ± 50
Smoke test/opacityM ⁻¹ %	2.5	2.0	2.5	2.5
Static timing method.....	Refer to wsm	Refer to wsm	Refer to wsm	Refer to wsm
Timing dimension.....mm	-	-	-	-
Crankshaft positionmm [°]	-	-	-	-
Turbo type / ref / pressure	-	-	-	-
Injection pump make	Bosch	Lucas	CAV	Bosch
Injection pump part no.....	VE	-	-	-
Injector Make / type	Pintle	Pintle	Pintle	Bosch
Injector part no.....	-	-	-	-
Injection type.....	VE	EEC V	Indirect	VE
Injection opening pressure, New [used]...bar	143	-	120 ± 6	143 ± 7
Glow plugs				
Maker	Motorcraft	Motorcraft	Motorcraft/Champion	Motorcraft/Champion
Type	EZD34	EZD39	EZD6 / CH147	EZD6 / CH147
Nominal rating.....V/A	11.5 / 16	11.5 / 16	11.5 / 16	11.5 / 16
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.5	1.5	1.5
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size	155x13: 175/70x13: 185/60x14	155x13: 175/70x13: 185/60x14	155x13: 175/70x13	155x13: 175/70x13
- Estate / Van.....Size	155x13: 175/70x13: 185/60x14	155x13: 175/70x13: 185/60x14	155x13: 165x13: 175/70x13	155x13: 165x13: 175/70x13
Pressure - front / rear - Saloon / Hatch...bar	2.0 / 1.8	2.0 / 1.8	2.0 / 1.8	2.0 / 1.8
- Estate / Van.....bar	2.0 / 1.8	2.0 / 1.8	2.0 / 1.8	2.0 / 1.8
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 ± 1.0	2.0 ± 1.0	-2.0 ± 1.0	-2.0 ± 1.0
Camber	-19' ± 14' ¹¹	-19' ± 14'	-15' ± 1°20'	-15' ± 1°20'
Castor	1°12' ± 1°20' ²	1°12' ± 1°20'	0 ± 1°15'	0 ± 1°15'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 ± 2.0	2.0 ± 2.0	2.0 ± 2.0	2.0 ± 2.0
Camber	-1° ± 50'	-1° ± 50'	-1° ± 30' -1°	-1° ± 30' -1°



FORD

	Escort & Orion 1.8 TD 1995 to 1999	Escort & Orion 1.8 TDi 1993 to 1999	Escort & Orion 1.8 1990 to 1998	Escort & Orion 1.8 1990 to 1998
Torque wrench settings				
Cylinder head - stage 1Nm	10 N	10 N	20 to 30	20 to 30
- stage 2Nm	100	100	76 to 92	76 to 92
- stage 3Nm	Wait 3 min.	Wait 3 min.	Wait 2 min.	Wait 2 min.
- stage 4Nm	- 180°	- 180°	+ 90°	+ 90°
- stage 5Nm	70	70	Bolts must not be retorqued	Bolts must not be retorqued
- stage 6Nm	+ 120°	+ 120°	-	-
Big-end bearings.....Nm	30 + 60° + 20° N	30 + 60° + 20° N	20 to 30° N	20 to 30° N
Main bearings.....Nm	27 + 75°	27 + 75°	27 + 45°	27 + 45°
Crankshaft pulley boltNm	150, slacken, 120 + 60°	150, slacken, 120 + 60°	180	180
Camshaft pulley boltNm	11 M8: 33	11 M8: 33	M6: 9 to 11 ²	M6: 9 to 11 ³
Flywheel [driveplate] bolt.....Nm	20 + 35° + 35°	20 + 35° + 35°	15 to 20°	15 to 20°
Front hubsNm	220 M22: 235	220 M22: 235	220 to 250	220 to 250
Rear hubsNm	260	260	250 to 270	250 to 270
Wheel nuts / boltsNm	100	100	70 to 100	70 to 100
Glow plugsNm	30	30	25 to 30	25 to 30
Clutch pressure plate boltsNm	30	30	25 to 34	25 to 34
Injection pump sprocket.....Nm	25	25	20 to 25	20 to 25
Injectors.....Nm	60 to 80	60 to 80	60 to 80	60 to 80
Injection pump mounting boltsNm	25	25	18 to 22	18 to 22
Injector pipe unions.....Nm	25	25	15 to 25	15 to 25
Capacities				
Engine oil & filter.....litres	4.5	4.5	4.5	4.5
Gearbox.....litres	2.8	2.8	3.1	3.1
Automatic transmissionlitres	-	-	-	-
Final drivelitres	WT	WT	WT	WT
Cooling system.....litres	9.3	9.3	9.3	9.3
Fuel tank.....litres	55	55	55	55
Notes				
<p>Escort & Orion 1.8 TD 1995 to 1999 ¹ Van: -1°47' to 1°01' ² Van: -0°43' to 1°57' ³ Turbo</p> <p>Escort & Orion 1.8 TDi 1993 to 1999 ¹ SOHC Turbo Intercooled</p> <p>Escort & Orion 1.8 1990 to 1998 ¹ + 60° + 20° ² M8: 27 to 33 ³ 45 + 0 - 10° + 45 + 0 - 10°</p> <p>Escort & Orion 1.8 1990 to 1998 ¹ RTH: catalyst ² + 60° + 20° ³ M8: 27 to 33 ⁴ + 45 + 0 - 10° + 45 + 0 - 10°</p>				
<p style="text-align: center;">1753 cm³</p>				
- Not applicable, or information not available				



FORD

	Focus 1.8 TDi 1999 to 2000	Sierra & Sapphire 1.8 TD 1990 to 1993	Mondeo 1.8 TD 1993 to 2000	Granada, Scorpio 2.5 Turbo 1988 to 1994
Engine				
Engine type/code	C9DC Endura DI ⁶ 66kW	RFA/RFB/RFL SOHC Turbo 55kW ¹	RFM/RFN ¹ SOHC Turbo 65kW	SFA/SFC OHV Turbo 68kW
Capacity (cm ³) / cylinders	1753 / 4	1753 / 4	1753 / 4	2498 / 4
Compression ratio / pressure	19.4 / ≥28	21.5 / 28 to 34	21.5 / 28.0 to 34.0	21.0 / 20 to 25
Torque output	200	0	180	0
Oil pressureidle [running] bar	0.75 [1.5 @ 2000]	0.75 [1.5]	0.75 [1.5 @ 2000]	1.2 [3.0]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.30 to 0.40	0.30 to 0.40	0.30 to 0.40	0.10 to 0.20
- exhaust (mm)	0.45 to 0.55	0.45 to 0.55	0.45 to 0.55	0.20 to 0.30
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	FE
Cooling system				
Thermostat opening temperature°C	-	85 to 89	85 to 89	69 to 72
Radiator cap pressurebar	-	1.00 to 1.25	refer to cap	1.0 to 1.2
Fuel system				
Idle speedrpm	800 ± 50	850 ± 50	850 to 860	875 to 900
Maximum (no load) speedrpm	-	5150 ± 50	5200 to 5300	4800 ± 50
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method	-	Refer to wsm	Refer to wsm	Dial gauge
Timing dimension.....mm	-	-	-	Dimension on pump
Crankshaft positionmm [°]	-	-	-	-
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make	Bosch	CAV	Lucas	CAV
Injection pump part no.....	VP30 234140	-	-	-
Injector Make / type	Multi hole	Pintle	-	Pintle
Injector part no.....	-	-	-	-
Injection type.....	EEC V Direct	Indirect	Indirect	DPCR
Injection opening pressure, New [used]...bar	≤1500	143 to 150	158 to 165	130 ± 5
Glow plugs				
Maker	Motorcraft	Motorcraft/Champion	Motorcraft	Motorcraft/Champion
Type	EZD 37	EZD6 / CH147	EZD 39	EZD5 / CH68
Nominal ratingV/A	-	11.5 / 16	-	11 / 8.5
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.5	-	1.5
Rear.....mm	1.0	1.0	-	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175/70x14:185/65x14:195/55x15	165x13: 185/70x13: 195/65x14 ²	185/65x14	175x14: 185/70x14
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.2 195: 2.0 / 2.0	1.8 / 1.8 ⁴	2.1 / 2.1	1.8 / 1.8
- Estate / Vanbar	2.2 / 2.2 195: 2.0 / 2.0	1.8 / 1.8	2.1 / 2.1	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 ± 1.0	2.0 ± 1.0	-0.5 to -3.5	2.0 ± 1.0
Camber	-0°32' Est: -0°32'	-21' ± 1° Estate: -25' ± 1° ⁶	-32' ± 1°18' Sport: -35' ± 1°15'	-23' ± 1° ¹
Castor	3° Est: 2°27'	1°52' Estate: 1°44' ⁵	2°19' ± 1° Sport: 2°21' ± 1°	1°51' ± 1° ²
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.1 to 5.1 Est: 0.1 to 4.1	-	3.9 to -0.1	-
Camber	-0°55' Est: -0°35'	-	-34' ± 19' Sport: -37' ± 1°	-



FORD

	Focus 1.8 TDi 1999 to 2000	Sierra & Sapphire 1.8 TD 1990 to 1993	Mondeo 1.8 TD 1993 to 2000	Granada, Scorpio 2.5 Turbo 1988 to 1994
Torque wrench settings				
Cylinder head - stage 1.....Nm	20	35 to 40	10 N	30
- stage 2.....Nm	54	70 to 75	100	70
- stage 3.....Nm	+ 160° ¹	Wait 1 min.	Wait 3 mins.	Slacken 90°
- stage 4.....Nm	-	70 to 75	- 180°	70, warm up,
- stage 5.....Nm	-	+ 90°	70	Allow to cool, slacken
- stage 6.....Nm	-	-	+ 120°	70 + 120°
Big-end bearings.....Nm	25 + 60° + 20° N	25 to 30* N	25 + 60° + 20° N	53 to 62 N
Main bearings.....Nm	27 + 75° N	27 + 75°	27 + 75°	100 to 120
Crankshaft pulley bolt.....Nm	120 - 90°, 150	180	150, slacken, 120 + 60°	55 + 60°
Camshaft pulley bolt.....Nm	35 M10: 48	M6: 9 to 11'	35	-
Flywheel [driveplate] bolt.....Nm	20 + 45°	15 to 20 ⁸	18 + 45° + 45°	15, 95
Front hubs.....Nm	316	310 to 350	340	390 to 450
Rear hubs.....Nm	235	250 to 290	290	250 to 290
Wheel nuts / bolts.....Nm	85	70 to 100	85	70 to 100
Glow plugs.....Nm	15	25 to 30	20	30 to 40
Clutch pressure plate bolts.....Nm	30	25 to 33	30	13 to 17
Injection pump sprocket.....Nm	33	20 to 25	25	-
Injectors.....Nm	23	70 to 80	95	90
Injection pump mounting bolts.....Nm	22	18 to 22	24	15 to 20
Injector pipe unions.....Nm	25	15 to 25	-	20 to 30
Capacities				
Engine oil & filter.....litres	5.6	5.1	5.1	5.6
Gearbox.....litres	2.6	1.25	2.6	1.2
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	0.9	WT	1.3
Cooling system.....litres	9.3	9.5	9.3	7.0
Fuel tank.....litres	52.7	60	61.5	70

Notes

Focus 1.8 TDi 1999 to 2000

¹Short bolt: 180°

²SOHC Turbo

Sierra & Sapphire 1.8 TD 1990 to 1993

¹RFA is 15.04. RFB, RFL are US87, RFL may be fitted with a catalyst

²Also: 185/65x14

³Also: 185/70x13

⁴165X13: 2.0 / 2.0

⁵WSM

⁶+ 55 to 60° + 15 to 20°

⁷M8: 27 to 33

⁸+ 35 to 40° + 35 to 40°

Mondeo 1.8 TD 1993 to 2000

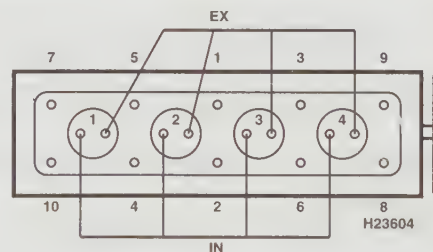
⁹With CAT

Granada, Scorpio 2.5 Turbo 1988 to 1994

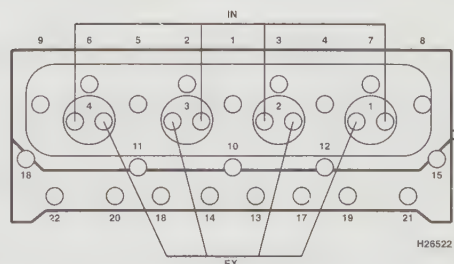
¹⁰►: -23°±1°. Low series: -10°±1°

²Self-levelling: 1°58'±1°. 90►: 2°25'±1°. Low series:

2°35'±1°



1753 cm³



2498 cm³

- Not applicable, or information not available

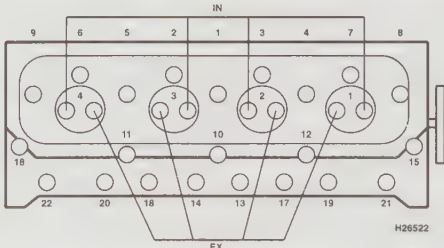
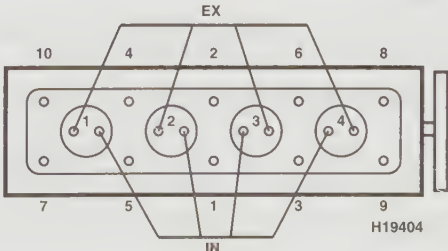


FORD

	Granada, Scorpio 2.5 TCI 1988 to 1994	Scorpio 2.5 TDi 1995 to 1998	Scorpio 2.5 TDi 1997 to 1998	Galaxy 1.9 TDi 1995 to 1999
Engine				
Engine type/code	SCB OHV Turbo 85kW	SCC OHV Turbo 85kW	SCD OHV Turbo 92kW	1Z/AHU SOHC Turbo 66kW
Capacity (cm ³) / cylinders	2498 / 4	2498 / 4	2498 / 4	1896 / 4
Compression ratio / pressure	21.0 / 20 to 25	21.0 / 24 to 26	21.0 / 24 to 26	19.5 / 25 to 30
Torque output	270	293	293	202
Oil pressureidle [running] bar	1.2 [3.0 @ 4000]	[4.0 @ 4000]	1.5 [4.0 @ 4000]	[2.0 @ 2000]
Oil temperature°C	80	80	100	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TCE	TCE	TCE	TBE
Cooling system				
Thermostat opening temperature°C	69 to 72	—	—	77
Radiator cap pressurebar	1.0 to 1.2	refer to cap	refer to cap	0.78 to 0.98
Fuel system				
Idle speedrpm	850 ± 50	875 ± 25	875 ± 55	860 to 940
Maximum (no load) speedrpm	4800 ± 50	—	4750	4800 to 5100
Smoke test/opacityM ⁻¹ %	2.0	2.0	2.0	2.0
Static timing method	Dial gauge	Dial gauge	Dial gauge	—
Timing dimension.....mm	0.61 to 0.62	0.65 ± 0.02	0.53 to 0.57	Computer controlled
Crankshaft positionmm [°]	TDC	TDC	TDC	—
Turbo type / ref / pressurebar	—	—	—	—
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VE L503	VE L503	VE4	—
Injector Make / type	Bosch	—	Bosch	Multi hole
Injector part no.....	DNSOD301	—	—	—
Injection type.....	Indirect	Indirect EDC	Indirect EEC V EDC	Direct EDC
Injection opening pressure, New [used]...bar	150 to 158	—	—	—
Glow plugs				
Maker	Motorcraft/Beru	Bosch	Bosch	Motorcraft/Bosch
Type	EZD30 / 909 MJ	0250 201 033	0250 201 033	EDZ40 / 0250 201 036
Nominal rating.....V/A	—	—	—	—
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.0	1.0	7.0 with backing
Rear.....mm	1.5	1.0	1.0	7.0 with backing
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/65x15	195/65x15: 215/60x15	195/65x15: 215/60x15	—
Pressure - front / rear - Saloon / Hatch...bar	205/60x15	195/65x15: 215/60x15	195/65x15: 215/60x15	195/65x15: 205/60x15: 215/60x15
- Estate / Van.....bar	2.0 / 2.0	2.0 / 2.0	2.0 / 2.0	—
	2.0 / 2.0	—	—	2.6 / 2.4 205: 2.7 / 2.5'
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 ± 1.0	2.0 ± 1.0	2.0 ± 1.0	[5' ± 10']
Camber	-23' ± 1°	-1°38' ± 1° Est: -1°41' ± 1°	-1°38' ± 1° Est: -1°41' ± 1°	-20' ± 45'
Castor	1°51' ± 1°	4°18' to 5° 48'	4°18' to 5° 48'	3°20' ± 40'
King pin inclination.....	—	—	—	—
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	—	—	—	[0 ± 25']
Camber	—	—	—	-20' ± 30'



FORD

	Granada, Scorpio 2.5 TCi 1988 to 1994	Scorpio 2.5 TDi 1995 to 1998	Scorpio 2.5 TDi 1997 to 1998	Galaxy 1.9 TDi 1995 to 1999
Torque wrench settings				
Cylinder head - stage 1.....Nm	30	10 ¹	30 ¹	40 N
- stage 2.....Nm	70	100	+ 70°	60
- stage 3.....Nm	Slacken 90°	wait 3 mins	+ 70°, warm up	+ 90°
- stage 4.....Nm	70, warm up	slacken	allow to cool, slacken	+ 90°
- stage 5.....Nm	Allow to cool, slacken	70 + 120°	30	-
- stage 6.....Nm	70 + 120°	-	+ 130° ²	-
Big-end bearings.....Nm	53 to 62 N	30 + 60° N	30 + 60° N	30 + 90° N
Main bearings.....Nm	100 to 120	42	42	65 + 90° N
Crankshaft pulley bolt.....Nm	55 + 60°	152	196	90 + 90° N
Camshaft pulley bolt.....Nm	-	-	-	45
Flywheel [driveplate] bolt.....Nm	15 then 95	20 + 60°	20 + 75°	60 + 90° N
Front hubs.....Nm	390 to 450	420	420	150 + 90°
Rear hubs.....Nm	250 to 290	270	270	200
Wheel nuts / bolts.....Nm	70 to 100	85	85	140
Glow plugs.....Nm	30 to 40	24	14	15
Clutch pressure plate bolts.....Nm	13 to 17	27	27	25
Injection pump sprocket.....Nm	-	88	88	55
Injectors.....Nm	90	70	70	22
Injection pump mounting bolts.....Nm	15 to 20	30	30	-
Injector pipe unions.....Nm	20 to 30	17	17	25
Capacities				
Engine oil & filter.....litres	5.6	6.6	6.6	4.3
Gearbox.....litres	1.2	1.2	1.2	2.0
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	1.3	1.3	1.3	WT
Cooling system.....litres	11.0	7.0	7.0	9.2
Fuel tank.....litres	70	70	70	70
Notes				
<p>Granada, Scorpio 2.5 TCi 1988 to 1994 ¹90 ▶: -23° ± 1° Low series: -10° ± 1° ²Self-levelling: 1°58' ± 1° 90 ▶: 2°25' ± 1° Low series 2°35' ± 1°</p> <p>Scorpio 2.5 TDi 1995 to 1998 ¹ Hexagon head bolts: 30, 92, wait 3 mins, + 90°</p> <p>Scorpio 2.5 TDi 1997 to 1998 ¹ M12: 30 + 85°, warm-up, allow to cool, 90 ² All bolts: + 15° after 20 000kms</p> <p>Galaxy 1.9 TDi 1995 to 1999 ¹215/60x15: 2.3 / 2.1</p>				
 <p style="text-align: center;">2498 cm³</p>  <p style="text-align: center;">1896 cm³</p>				
- Not applicable, or information not available				



FORD

	Galaxy 1.9 TDi 1996 to 2000	Maverick 2.7 TD 1993 to 1996	Maverick 2.7 TDi 1996 to 1998	P100 1.8 Turbo 1989 to 1992
Engine				
Engine type/code	AFN SOHC Turbo 81kW	TD27T VP OHV Turbo 73kW	TD27E VP OHV Turbo 92kW	RFA SOHC Turbo 55kW
Capacity (cm ³) / cylinders	1896 / 4	2663 / 4	2663 / 4	1753 / 4
Compression ratio / pressure	19.5 / 25 to 30	21.9 / _	21.9 / 29	21.5 / 28 to 34
Torque output	235	221	270	0
Oil pressureidle [running] bar	[2.0]	0.78 [2.9 to 3.9 @ 3000]	0.78 [2.94 to 3.92]	0.75 [1.5]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0.25 H	0.25 H	0.30 to 0.40
- exhaust (mm)	0: Hyd.	0.25 H	0.25 H	0.45 to 0.55
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TCE	TCE	TBE
Cooling system				
Thermostat opening temperature°C	-	82	82	85 to 89
Radiator cap pressurebar	-	0.78 to 0.98	0.78 to 0.98	1.2 to 1.5
Fuel system				
Idle speedrpm	860 to 940	700 ± 50	700 ± 50	850 ± 50
Maximum (no load) speedrpm	4800 to 5200	5050	5050	5150 ± 50
Smoke test/opacityM ⁻¹ %	2.0	2.5	2.0	2.5
Static timing method	-	Plunger travel	Plunger travel	Refer to wsm
Timing dimension	Computer controlled	0.38 ± 0.02	0.38 ± 0.02	-
Crankshaft positionmm [°]	-	[0] TDC	[0] TDC	-
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make	Bosch	Diesel Kiki	Diesel Kiki	CAV
Injection pump part no.	VER 510	VE	NP VE4	-
Injector Make / type	Multi hole	Bosch	Bosch	Pintle
Injector part no.	DSL150 P 520	-	-	-
Injection type	Direct EDC	Indirect EDC	Indirect EDC	Indirect
Injection opening pressure, New [used] ...bar	190 to 200 [170]	105 to 113 [98 to 103]	103 to 123 [98 to 103]	143 to 150
Glow plugs				
Maker	Motorcraft/Bosch	Beru	Motorcraft	Motorcraft/Champion
Type	EDZ40 / 0250 202 009	854 MJ	1 960 555	EZD6 / CH147
Nominal ratingV/A	11 / 12	-	-	11.5 / 16
Brakes				
minimum friction material thickness				
Frontmm	7.0 with backing	2.0	2.0	1.5
Rearmm	7.0 with backing	2.0	2.0	1.0
Tyres - Saloon / Hatch				
- Estate / Van	195/65x15: 205/60x15:215/60x15	215/80x15: 235/75x15	215/80x15: 235/75x15	185x14
Pressure - front / rear - Saloon / Hatch ...bar	-	-	-	-
- Estate / Vanbar	2.6 / 2.4 205: 2.7 / 2.5'	3D: 1.8 / 2.2 ²	3D: 1.8 / 2.2 ²	1.8 / 2.5
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-)mm [°]	[5' ± 10']	3.0 to 5.0	3.0 to 5.0	2.0 ± 2.0
Camber	-20' ± 45'	0 to 1°	0 to 1°	30' +1° -1°30'
Castor	3°20' ± 40'	1°10' to 2°10'	1°10' to 2°10'	1°39' +1°30' -1°
King pin inclination	-	7°36' to 8°36'	7°36' to 8°36'	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-)mm [°]	[0 ± 25']	-	-	-
Camber	-20' ± 30'	-	-	-



FORD

	Galaxy 1.9 TDi 1996 to 2000	Maverick 2.7 TD 1993 to 1996	Maverick 2.7 TDi 1996 to 1998	P100 1.8 Turbo 1989 to 1992
Torque wrench settings				
Cylinder head - stage 1.....Nm	40 N	42 ¹	42 ¹	35 to 40
- stage 2.....Nm	60	57	57	70 to 75
- stage 3.....Nm	+ 90°	+ 90°	+ 90°	Wait 1 min.
- stage 4.....Nm	+ 90°	-	-	70 to 75
- stage 5.....Nm	-	-	-	+ 90°
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	30 + 90° N	63 N	63 N	25 to 30 ¹
Main bearings.....Nm	65 + 90° N	172	172	27 + 75°
Crankshaft pulley bolt.....Nm	90 + 90° N	309	309	180
Camshaft pulley bolt.....Nm	45	-	-	M6: 9 to 11 ²
Flywheel [driveplate] bolt.....Nm	60 + 90° N	152	152	15 to 20 ³
Front hubs.....Nm	150 + 90°	WSM	WSM	390 to 450
Rear hubs.....Nm	200	WSM	WSM	280 to 300
Wheel nuts / bolts.....Nm	140	123	123	85 to 90
Glow plugs.....Nm	15	18	18	25 to 30
Clutch pressure plate bolts.....Nm	25	26	26	25 to 33
Injection pump sprocket.....Nm	55	64	64	20 to 25
Injectors.....Nm	20	59	59	70 to 80
Injection pump mounting bolts.....Nm	25	23	23	18 to 22
Injector pipe unions.....Nm	25	23	23	15 to 25
Capacities				
Engine oil & filter.....litres	4.3	7.2	7.2	5.5
Gearbox.....litres	2.0	3.5 Transfer: 2.3	3.5 Transfer: 2.3	1.25 MT75: 1.2
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	Rear: 2.8	Rear: 2.8	1.4
Cooling system.....litres	9.2	10.0	10.0	9.5
Fuel tank.....litres	70	3D: 72 5D: 80	3D: 72 5D: 80	60

Notes

Galaxy 1.9 TDi 1996 to 2000

¹215/60x15: 2.3 / 2.1

Maverick 2.7 TD 1993 to 1996

¹Re-use once only

²5D: 1.9 / 2.5

Maverick 2.7 TDi 1996 to 1998

¹Re-use once only

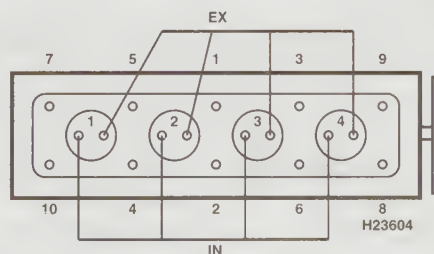
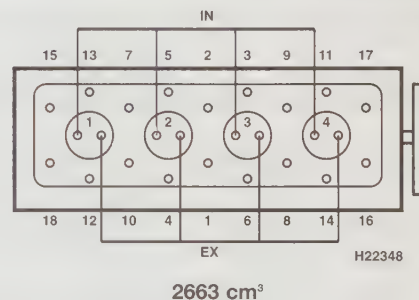
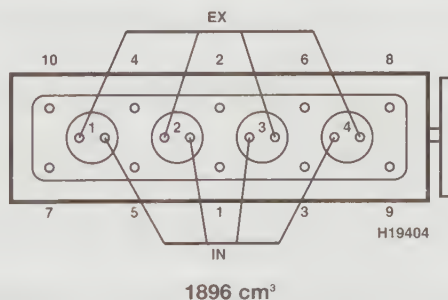
²5D: 1.9 / 2.5

P100 1.8 Turbo 1989 to 1992

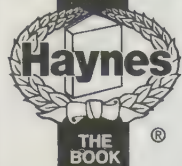
¹+ 55 to 60° + 15 to 20°

²M8: 27 to 33

³+ 35 to 40° + 35 to 40°



- Not applicable, or information not available



FORD

	Transit 2.5 1989 to 1991	Transit 2.5 1989 to 1991	Transit 2.5 Turbo 1989 to 1994	Transit 2.5 1991 to 1993
Engine				
Engine type/code.....	4CA OHV 52kW	4CA OHV 52kW	4AE OHV Turbo 60kW	4FA OHV 52kW
Capacity (cm ³) / cylinders.....	2496 / 4	2496 / 4	2496 / 4	2498 / 4
Compression ratio / pressurebar	19.0 / 33.8	19.0 / 33.8	19.0 / 33.8	19.0 / 33
Torque outputNm	0	0	0	0
Oil pressureidle [running] bar	[2.7 to 4.8]	[2.7 to 4.8]	[2.7 to 4.8]	1.0
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0.20	0.20	0.20	0.20
- exhaust (mm).....	0.38	0.38	0.40	0.38
Injection order.....	1-2-4-3	1-2-4-3	1-2-4-3	1-2-4-3
No. 1 cylinder position.....	-	TBE	TBE	-
Cooling system				
Thermostat opening temperature°C	82	82	82	88 to 102
Radiator cap pressurebar	0.85 to 1.10	0.85 to 1.10	0.85 to 1.10	1.0
Fuel system				
Idle speedrpm	800 to 850	800 to 850	825 ± 25	825 ± 25
Maximum (no load) speedrpm	4320 to 4480	4320 to 4560	4320 to 4560	4480
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Refer to wsm	Refer to wsm	Refer to wsm	Refer to wsm
Timing dimension.....mm	-	-	-	-
Crankshaft positionmm [°]	-	[11] BTDC	[11] BTDC	-
Turbo type / ref / pressurebar	-	-	0.67 bar	-
Injection pump make.....	CAV	Bosch	Lucas	Bosch
Injection pump part no.....	-	0460 414 051	-	0460 414 083
Injector Make / type.....	CAV	Bosch	-	-
Injector part no.....	-	-	-	-
Injection type.....	Direct	Direct	Direct EPIC	Direct VE
Injection opening pressure, New [used]...bar	275 [241]	275 [241]	275 [241]	275 to 280 [240 to 266]
Glow plugs				
Maker.....	Beru	Beru	Beru	Motorcraft
Type.....	GF859	GF859	GF859	EZD26
Nominal rating.....V/A	-	-	-	-
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.5	1.5	1.5
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185x14: 195x14	185x14: 195x14	185x14: 195x14	185x14: 195x14: 215/70x15'
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Van.....bar	Owners Handbook	Owners handbook	Owners handbook	WSM
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 to 1.6	0 to 1.6	0 to 1.6	0 ± 0.5
Camber.....	-30' to 2°30' ¹¹	-30' to 2°30' ¹¹	-30' to 2°30' ¹¹	WSM
Castor.....	15' to 4°30' ¹²	15' to 4°30' ¹²	15' to 4°30' ¹²	WSM
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-	-	-
Camber.....	-	-	-	-



FORD

	Transit 2.5 1989 to 1991	Transit 2.5 1989 to 1991	Transit 2.5 Turbo 1989 to 1994	Transit 2.5 1991 to 1993
Torque wrench settings				
Cylinder head - stage 1	Nm 70	70	70	70
- stage 2	Nm Slacken	Slacken	Slacken	Slacken
- stage 3	Nm 70	70	70	70
- stage 4	Nm + 90°	+ 90°	+ 90°	+ 90°
- stage 5	Nm -	-	-	-
- stage 6	Nm -	-	-	-
Big-end bearings.....	Nm 47 to 65 ¹	47 to 65 ²	47 to 65 ³	72 N
Main bearings.....	Nm 110 to 126 ⁴	110 to 126 ⁴	110 to 126 ⁴	180
Crankshaft pulley bolt	Nm M14: 144 to 184 ⁵	M14: 144 to 184 ⁵	M14: 144 to 184 ⁵	320
Camshaft pulley bolt	Nm 8 to 12 + 60°	8 to 12 + 60°	8 to 12 + 60°	12 + 60°
Flywheel [driveplate] bolt.....	Nm 59 to 67	59 to 67	59 to 67	65
Front hubs	Nm WSM	WSM	WSM	WSM
Rear hubs	Nm WSM	WSM	WSM	WSM
Wheel nuts / bolts	Nm 5 stud: 75 to 95 ⁶	5 stud: 75 to 95 ⁶	5 stud: 75 to 95 ⁶	5 stud: 80 6 stud: 168
Glow plugs	Nm -	-	-	-
Clutch pressure plate bolts	Nm 17 to 21	17 to 21	17 to 21	19
Injection pump sprocket.....	Nm 22 to 27	22 to 27	22 to 27	27
Injectors.....	Nm 40	40	40	40
Injection pump mounting bolts	Nm 21 to 26	21 to 26	21 to 26	25
Injector pipe unions.....	Nm 18 to 20	18 to 20	18 to 20	20
Capacities				
Engine oil & filter.....	litres 6.2	6.2	6.2	7.0
Gearbox.....	litres Type F: 1.5 ⁷	Type F: 1.5 ⁷	Type F: 1.5 ⁷	1.25
Automatic transmission	litres 6.3 A4LD: 8.5	6.3 A4LD: 8.5	6.3 A4LD: 8.5	8.5
Final drive	litres Type G: 1.7 ⁸	Type G: 1.7 ⁸	Type G: 1.7 ⁸	Type G: 1.7 ⁸
Cooling system.....	litres 11.6	11.6	11.6	8.4
Fuel tank.....	litres 68	68	68	68

Notes

Transit 2.5 1989 to 1991

¹Beam axle: 30° to 1°30'

²Beam axle: 2° to 5°45'

³Then 65 to 72

⁴Stage 2: Centre: 140 to 155. Others: 126 to 140

⁵M24: 312 to 346

⁶6 stud: 155 to 180

⁷Type G: 2.0 [Type N: 1.5]. O/D: 3.1. MT 75: 1.2

⁸Type H axle: 2.7. Type F: 1.4

Transit 2.5 1989 to 1991

¹Beam axle: +30° to 1°30'

²Beam axle: +2° to 5°45'

³Then 65 to 72

⁴Stage 2: Centre: 140 to 155. Others: 126 to 140

⁵M24: 312 to 346

⁶6 stud: 155 to 180

⁷Type G: 2.0 [Type N: 1.5]. O/D: 3.1. MT 75: 1.2

⁸Type H axle: 2.7. Type F: 1.4

Transit 2.5 Turbo 1989 to 1994

¹Beam axle: +30° to 1°30'

²Beam axle: +2° to 5°45'

³Then 65 to 72

⁴Stage 2: Centre: 140 to 155. Others: 126 to 140

⁵M24: 312 to 346

⁶6 stud: 155 to 180

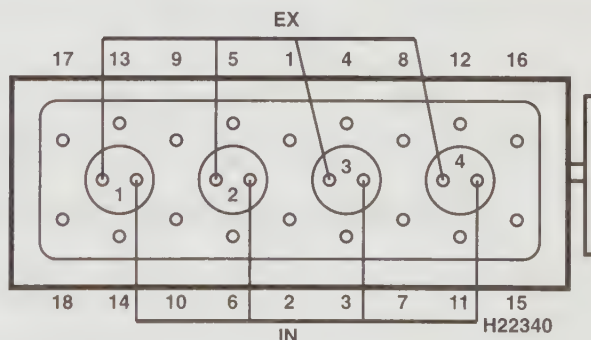
⁷Type G: 2.0 [Type N: 1.5]. O/D: 3.1. MT 75: 1.2

⁸Type H axle: 2.7. Type F: 1.4

Transit 2.5 1991 to 1993

¹185x15: 225/70x15 may be fitted

²Type H axle: 2.7



2496 cm³ / 2498 cm³

– Not applicable, or information not available



FORD

	Transit 2.5 1991 to 1993	Transit 2.5 1991 to 1993	Transit 2.5 Turbo 1991 to 1994	Transit 2.5 Turbo 1991 to 1994
Engine				
Engine type/code	4DA OHV 59kW	4DA OHV 59kW	4GA OHV Turbo 63kW	4EA OHV Turbo 74kW
Capacity (cm ³) / cylinders	2498 / 4	2498 / 4	2498 / 4	2498 / 4
Compression ration / pressurebar	19.0 / 33	19.0 / 33	18.3 /	18.3 / 33.8
Torque outputNm	0	0	200	0
Oil pressureidle [running] bar	1.0	1.0	1.0	1.0 [2.7 to 4.8]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.20	0.20	0.20	0.20
- exhaust (mm)	0.38	0.38	0.38	0.40
Injection order	1-2-4-3	1-2-4-3	1-2-4-3	1-3-4-2
No. 1 cylinder position	-	-	-	TBE
Cooling system				
Thermostat opening temperature°C	88 to 102	88 to 102	88 to 102	88 to 102
Radiator cap pressurebar	1.0	1.0	1.0	1.0
Fuel system				
Idle speedrpm	825 ± 25	825 ± 25	850 ± 25	800 to 90
Maximum (no load) speedrpm	4480	4480	4480	4480
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method	Refer to wsm	Refer to wsm	Refer to wsm	Refer to wsm
Timing dimension.....mm	-	-	-	-
Crankshaft positionmm [°]	-	-	-	-
Turbo type / ref / pressurebar	-	-	0.64 bar	0.67 bar
Injection pump make	Bosch	CAV	Lucas	Lucas
Injection pump part no.....	0460 414 083	-	-	-
Injector Make / type	-	-	-	-
Injector part no.....	-	-	-	Stanadyne
Injection type.....	Direct VE	Direct	Direct EPIC	EPIC
Injection opening pressure, New [used]...bar	275 to 280 [240 to 266]	275 to 280 [240 to 266]	280 [266]	280 [260]
Glow plugs				
Maker	Motorcraft	Motorcraft	Motorcraft	Motorcraft
Type	EZD26	EZD26	EZD31	EZD26
Nominal ratingV/A	-	-	-	-
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.5	1.5	1.5
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185x14; 195x14; 215/70x15'	185x14; 195x14; 215/70x15'	185x14; 195x14; 215/70x15'	185x14; 195x14; 215/70x15'
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	WSM	WSM	WSM	WSM
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 0.5	0 ± 0.5	0 ± 0.5	0 ± 0.5
Camber	WSM	WSM	WSM	WSM
Castor	WSM	WSM	WSM	WSM
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-	-	-
Camber	-	-	-	-



FORD

	Transit 2.5 1991 to 1993	Transit 2.5 1991 to 1993	Transit 2.5 Turbo 1991 to 1994	Transit 2.5 Turbo 1991 to 1994
Torque wrench settings				
Cylinder head - stage 1.....Nm	70 N	70 N	70 N	70 N
- stage 2.....Nm	Slacken	Slacken	Slacken	Slacken
- stage 3.....Nm	70	70	70	70
- stage 4.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	72 N	72 N	64 N	72 N
Main bearings.....Nm	180	180	170	170
Crankshaft pulley bolt.....Nm	320	320	320	185
Camshaft pulley bolt.....Nm	12 + 60°	12 + 60°	12 + 60°	12 + 60°
Flywheel [driveplate] bolt.....Nm	65	65	67	25 + 30°
Front hubs.....Nm	WSM	WSM	WSM	WSM
Rear hubs.....Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	5 stud: 80 6 stud: 168	5 stud: 80 6 stud: 168	5 stud: 80 6 stud: 168	5 stud: 80 6 stud: 168
Glow plugs.....Nm	-	-	-	21 to 27
Clutch pressure plate bolts.....Nm	19	19	19	19
Injection pump sprocket.....Nm	27	27	27	-
Injectors.....Nm	40	40	40	-
Injection pump mounting bolts.....Nm	25	25	-	42
Injector pipe unions.....Nm	20	20	20	20
Capacities				
Engine oil & filter.....litres	7.0	7.0	6.0	6.0
Gearbox.....litres	1.25	1.25	1.25	1.25
Automatic transmission.....litres	8.5	8.5	8.5	8.5
Final drive.....litres	Type G: 1.7 ²	Type G: 1.7 ²	Type G: 1.7 ²	Type G: 1.7 ²
Cooling system.....litres	8.4	8.4	8.4	8.4
Fuel tank.....litres	68	68	68	68

Notes

Transit 2.5 1991 to 1993

*185x15: 225/70x15 may be fitted

*Type H axle: 2.7

Transit 2.5 1991 to 1993

*185x15: 225/70x15 may be fitted

*Type H axle: 2.7

Transit 2.5 Turbo 1991 to 1994

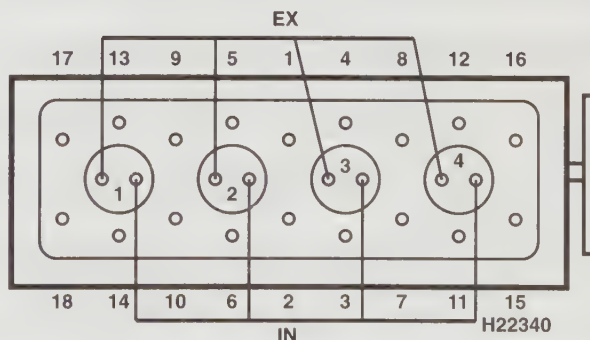
*185x15: 225/70x15 may be fitted

*Type H axle: 2.7

Transit 2.5 Turbo 1991 to 1994

*185x15: 225/70x15 may be fitted

*Type H axle: 2.7



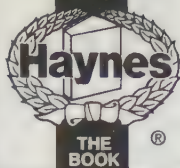
2498 cm³

- Not applicable, or information not available

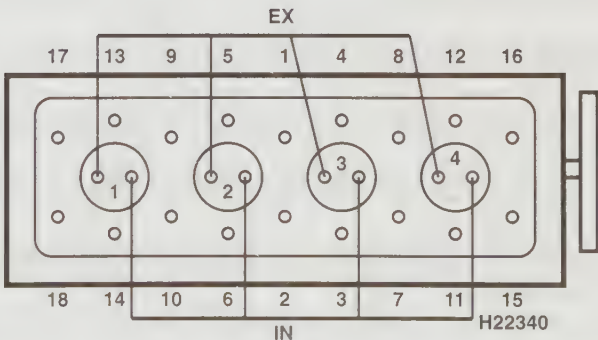


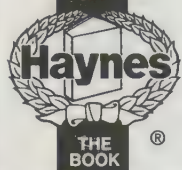
FORD

	Transit 2.5 Turbo 1995 to 2000	Transit 2.5 TDi 1997 to 2000	Transit 2.5 TDi 1997 to 2000	Transit 2.5 Di 1993 to 2000
Engine				
Engine type/code.....	4EB/4EC OHV Turbo 74kW	4GC/4GB OHV Turbo 63kW	4GD/4GE/4GF OHV Turbo 63kW	4FB/4FC/4FD OHV 52kW
Capacity (cm ³) / cylinders	2498 / 4	2496 / 4	2496 / 4	2496 / 4
Compression ratio / pressure	18.3 /	18.3 /	19.0 /	20.8 /
Torque output	220	200	200	145
Oil pressureidle [running] bar	[2.7 to 4.8 @ 4000]	1.6 [3.1 @ 2000]	1.6 [3.1 @ 2000]	[2.7 to 4.8]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.20	0.20	0.20	0.20
- exhaust (mm)	0.38	0.38	0.38	0.38
Injection order	1-2-4-3	1-2-4-3	1-2-4-3	1-2-4-3
No. 1 cylinder position	-	-	-	TBE
Cooling system				
Thermostat opening temperature°C	88 to 102	-	-	-
Radiator cap pressurebar	1.0	refer to cap	refer to cap	refer to cap
Fuel system				
Idle speedrpm	850 ± 25	850 ± 50	850 ± 50	850 ± 25
Maximum (no load) speedrpm	4400	4400	4400	4280 to 4480
Smoke test/opacityM ⁻¹ %	2.5	2.0	2.0	2.5
Static timing method.....	Refer to wsm	Refer to wsm	Refer to wsm	Refer to wsm
Timing dimension.....mm	-	-	-	-
Crankshaft positionmm [°]	-	-	-	-
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make	Lucas	Lucas	Lucas	Bosch
Injection pump part no.....	-	-	-	VE
Injector Make / type	-	-	-	-
Injector part no.....	-	-	-	-
Injection type.....	Direct EPIC	Direct EPIC	Direct EPIC	Direct
Injection opening pressure, New [used]...bar	-	-	280 [260]	-
Glow plugs				
Maker	Motorcraft	Motorcraft	Motorcraft	-
Type	EZD31	EZD31	EZD31	-
Nominal ratingV/A	-	-	-	-
Brakes				
minimum friction material thickness				
Front.....mm	1.5	-	-	-
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185x14: 195x14: 215/70x15'	195x14	195x14	195x14
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	Owners handbook	Owners handbook	Owners handbook	2.8 / 2.6
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 0.5	0.0 ± 1.0	0.0 ± 1.0	0.0 ± 1.0
Camber	WSM	-52' to 1°8'	-52' to 1°8'	-0°52' to 1°08'
Castor	WSM	1°9' to 4°9'	1°9' to 4°9'	1°09' to 4°09'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-	-	-
Camber	-	-	-	-



FORD

	Transit 2.5 Turbo 1995 to 2000	Transit 2.5 TDi 1997 to 2000	Transit 2.5 TDi 1997 to 2000	Transit 2.5 Di 1993 to 2000
Torque wrench settings				
Cylinder head - stage 1.....Nm	70	70	70	70
- stage 2.....Nm	Slacken	70	70	70
- stage 3.....Nm	70	+ 90°	+ 90°	+ 90°
- stage 4.....Nm	+ 90°	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	70 N	69 N	69 N	69 N
Main bearings.....Nm	120	84, 170	84, 170	84, 170
Crankshaft pulley bolt.....Nm	163	163	163	163
Camshaft pulley bolt.....Nm	160	-	-	10 + 60°
Flywheel [driveplate] bolt.....Nm	21 + 30°	21 + 30°	21 + 30°	21 + 28°
Front hubs.....Nm	WSM	WSM	WSM	WSM
Rear hubs.....Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	5 stud: 80. 6 stud: 168	80 6 stud: 168	80 6 stud: 168	85 6 stud: 168
Glow plugs.....Nm	-	18	18	-
Clutch pressure plate bolts.....Nm	30	30	30	30
Injection pump sprocket.....Nm	-	-	25	-
Injectors.....Nm	-	40	40	-
Injection pump mounting bolts.....Nm	-	-	25	-
Injector pipe unions.....Nm	-	-	19	-
Capacities				
Engine oil & filter.....litres	6.0	6.0	6.0	6.0
Gearbox.....litres	1.25	1.25	1.25	1.25
Automatic transmission.....litres	8.5	-	-	-
Final drive.....litres	Type G: 1.7 ²	1.72 Type 34: 2.70	1.72 Type 34: 2.70	1.72
Cooling system.....litres	8.4	7.9	11.6	11.6
Fuel tank.....litres	68	68	68	68
Notes				
Transit 2.5 Turbo 1995 to 2000 ¹ 185x15: 225/70x15 may be fitted ² Type H axle: 2.7				
 <p>2496 cm³ / 2498 cm³</p>				
- Not applicable, or information not available				



FORD

	Transit 2.5 Di 1996 to 2000	Transit 2.5 Di 1997 to 2000	Transit 2.5 TDi 1995 to 2000	Transit 2.5 TCi 1995 to 2000
Engine				
Engine type/code.....	4HB OHV 56kW	4HC OHV 56kW	4HA/4HD OHV Turbo 55kW	4ED OHV Turbo 85kW
Capacity (cm ³) / cylinders.....	2496 / 4	2496 / 4	2496 / 4	2496 / 4
Compression ratio / pressure.....bar	20.6 /	20.8 /	20.6 /	20.6 /
Torque output.....Nm	168	168	145	255
Oil pressure.....idle [running] bar	2.7	2.7	2.7	2.7
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0.20	0.20	0.20	0.20
- exhaust (mm).....	0.38	0.38	0.40	0.40
Injection order.....	1-2-4-3	1-2-4-3	1-2-4-3	1-2-4-3
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature.....°C	-	-	-	-
Radiator cap pressure.....bar	refer to cap	refer to cap	refer to cap	refer to cap
Fuel system				
Idle speed.....rpm	800 to 850	850 ± 25	850 ± 50	850 ± 50
Maximum (no load) speed.....rpm	4320 to 4480	4320 to 4480	4280 to 4480	4280 to 4480
Smoke test/opacity.....M ⁻¹ %	2.5	2.5	2.0	2.0
Static timing method.....	Refer to wsm	Refer to wsm	Refer to wsm	Refer to wsm
Timing dimension.....mm	-	-	-	-
Crankshaft position.....mm [°]	-	-	-	-
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	Bosch	-	Lucas	Lucas
Injection pump part no.....	VE	-	-	-
Injector Make / type.....	-	-	-	-
Injector part no.....	-	-	-	-
Injection type.....	Direct	Direct	Direct EPIC	Direct EPIC
Injection opening pressure, New [used]...bar	-	-	-	-
Glow plugs				
Maker.....	Motorcraft	Motorcraft	Motorcraft	Motorcraft
Type.....	EDZ31	EDZ31	EDZ31	EDZ31
Nominal rating.....V/A	-	-	-	-
Brakes				
minimum friction material thickness				
Front.....mm	1.0	-	-	1.0
Rear.....mm	1.5	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	215/70x15	215/70x15	195x14	195x14
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Van.....bar	2.7 / 4.2	2.7 / 4.2	2.8 / 2.6	2.8 / 2.6
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.0 ± 1.0	0.0 ± 1.0	0.0 ± 1.0	0.0 ± 1.0
Camber.....	-0°53' to 1° 06'	-0°53' to 1° 06'	-0°52' to 1°08'	-0°52' to 1°08'
Castor.....	-0°04' to 2° 56'	-0°04' to 2° 56'	1°09' to 4°09'	1°09' to 4°09'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-	-	-
Camber.....	-	-	-	-

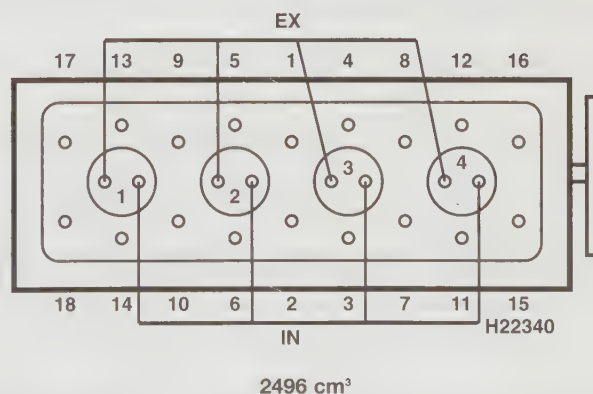


FORD

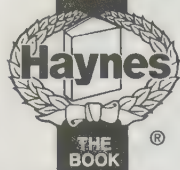
	Transit 2.5 Di 1996 to 2000	Transit 2.5 Di 1997 to 2000	Transit 2.5 TDi 1995 to 2000	Transit 2.5 TCi 1995 to 2000
Torque wrench settings				
Cylinder head - stage 1Nm	70	70	70	30' WSM
- stage 2Nm	70	70	70	+ 70°
- stage 3Nm	+ 90°	+ 90°	+ 90°	+ 70°
- stage 4Nm	-	-	-	-
- stage 5Nm	-	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	69 N	69 N	69 N	69 N
Main bearings.....Nm	84, 170	84, 170	84, 170	84, 170
Crankshaft pulley boltNm	163	163	163	163
Camshaft pulley boltNm	160	-	-	-
Flywheel [driveplate] bolt.....Nm	21 + 20°	21 + 20°	21 + 28°	21 + 28°
Front hubsNm	WSM	WSM	WSM	WSM
Rear hubsNm	WSM	WSM	WSM	WSM
Wheel nuts / boltsNm	85 6 stud: 168	85 6 stud: 168	85 6 stud: 168	85 6 stud: 168
Glow plugsNm	-	-	-	-
Clutch pressure plate boltsNm	30	30	30	30
Injection pump sprocket.....Nm	25	-	-	25
Injectors.....Nm	40	-	-	40
Injection pump mounting boltsNm	24	23	-	24
Injector pipe unions.....Nm	20	-	-	20
Capacities				
Engine oil & filter.....litres	6.0	6.0	6.0	6.0
Gearbox.....litres	1.25	1.25	1.25	1.25
Automatic transmissionlitres	-	-	-	-
Final drive.....litres	1.75	1.75	1.72	1.72
Cooling system.....litres	11.6	11.6	11.6	11.6
Fuel tank.....litres	68	68	68	68

Notes

Transit 2.5 TCi 1995 to 2000
 'M12 bolts: 30 + 85°



- Not applicable, or information not available



		Caro 1.9D 1994 to 1999		
Engine				
Engine type/code	XUD9 EJ SOHC 51kW			
Capacity (cm ³) / cylinders	1905 / 4			
Compression ratio / pressurebar	23.0 /			
Torque outputNm	0			
Oil pressureidle [running] bar	[3.4 @ 4000]			
Oil temperature°C	80			
Valve clearances - inlet (mm)	0.07 to 0.23			
- exhaust (mm)	0.22 to 0.38			
Injection order	1-3-4-2			
No. 1 cylinder position	FE			
Cooling system				
Thermostat opening temperature°C	-			
Radiator cap pressurebar	-			
Fuel system				
Idle speedrpm	750 to 800			
Maximum (no load) speedrpm	5100			
Smoke test/opacityM ⁻¹ %	2.5			
Static timing method.....	Plunger travel			
Timing dimension.....mm	0.9			
Crankshaft positionmm [°]	TDC			
Turbo type / ref / pressurebar	-			
Injection pump make	Bosch			
Injection pump part no.....	VER 272 2			
Injector Make / type	Bosch			
Injector part no.....	DNOSD287			
Injection type.....	Indirect			
Injection opening pressure, New [used]...bar	125 to 135			
Glow plugs				
Maker	Bosch			
Type	0250 201 019			
Nominal rating.....V/A	11 / 13			
Brakes				
minimum friction material thickness				
Front.....mm	1.0			
Rear.....mm	1.5			
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	-			
Pressure - front / rear - Saloon / Hatch...bar	-			
- Estate / Vanbar	-			
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	3 ± 1			
Camber	0°30' ± 10'			
Castor	4°30' ± 30'			
King pin inclination.....	-			
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-			
Camber	-			



FSO

Caro 1.9D
1994 to 1999

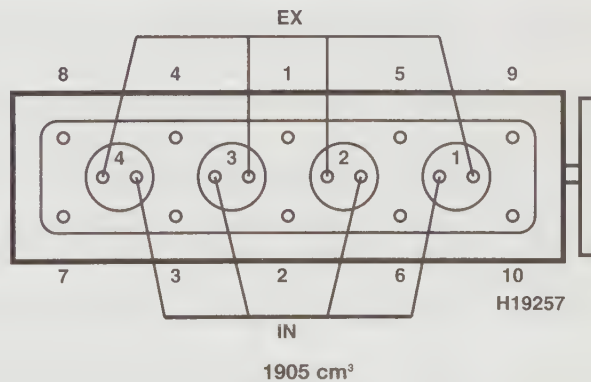
Torque wrench settings

Cylinder head - stage 1	Nm	30
- stage 2	Nm	70
- stage 3	Nm	+ 120°
- stage 4	Nm	-
- stage 5	Nm	-
- stage 6	Nm	-
Big-end bearings	Nm	50 N
Main bearings	Nm	70
Crankshaft pulley bolt	Nm	40 + 60°
Camshaft pulley bolt	Nm	35
Flywheel [driveplate] bolt	Nm	-
Front hubs	Nm	-
Rear hubs	Nm	-
Wheel nuts / bolts	Nm	85
Glow plugs	Nm	22
Clutch pressure plate bolts	Nm	22
Injection pump sprocket	Nm	-
Injectors	Nm	-
Injection pump mounting bolts	Nm	18
Injector pipe unions	Nm	22

Capacities

Engine oil & filter	litres	5.0
Gearbox	litres	1.6
Automatic transmission	litres	-
Final drive	litres	WT
Cooling system	litres	-
Fuel tank	litres	-

Notes

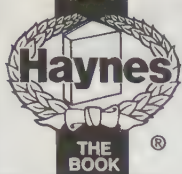


- Not applicable, or information not available



HONDA

	Civic 2.0 TDi 1997 to 2000	Accord 2.0 TDi 1996 to 1998		
Engine				
Engine type/code	20T2R/N ¹ SOHC Turbo 64kW	20T2N SOHC Turbo 76kW		
Capacity (cm ³) / cylinders	1994 / 4	1994 / 4		
Compression ratio / pressure	19.5 /	19.5 /		
Torque output	170 Nm	210		
Oil pressureidle [running] bar	0.7	0.7 [3.8 @ 3000]		
Oil temperature°C	80	80		
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.		
- exhaust (mm)	0: Hyd.	0: Hyd.		
Injection order	1-3-4-2	1-3-4-2		
No. 1 cylinder position	-	-		
Cooling system				
Thermostat opening temperature°C	82	82		
Radiator cap pressurebar	0.9	1.1		
Fuel system				
Idle speedrpm	850 ± 50	805 ± 50		
Maximum (no load) speedrpm	-	-		
Smoke test/opacityM ⁻¹ %	2.0	2.0		
Static timing method	-	-		
Timing dimension.....mm	Computer controlled	Computer controlled		
Crankshaft positionmm [°]	-	-		
Turbo type / ref / pressurebar	-	-		
Injection pump make	Bosch	Bosch		
Injection pump part no.....	VP21	L 580		
Injector Make / type	-	Bosch		
Injector part no.....	-	KBAL 70P45		
Injection type.....	ECU controlled	Direct EDC		
Injection opening pressure, New [used]...bar	200	200 to 330		
Glow plugs				
Maker	-	Bosch		
Type	-	0250 202 025		
Nominal rating.....V/A	-	-		
Brakes				
minimum friction material thickness				
Front.....mm	1.6	1.6		
Rear.....mm	1.6	1.6		
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185/60x14	185/65x15		
Pressure - front / rear - Saloon / Hatch...bar	-	-		
- Estate / Vanbar	2.5 / 2.2	2.2 / 2.2		
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 12°]	0.0 ± 3.0		
Camber	0° ± 1°	0° ± 1°		
Castor	1° 10'	3° ± 1°		
King pin inclination.....	-	-		
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.3	-2.0 ± 2.0		
Camber	-0° 50'	-0° 30' ± 30'		



HONDA

Civic 2.0 TDi
 1997 to 2000

Accord 2.0 TDi
 1996 to 1998

Torque wrench settings

Cylinder head - stage 1.....Nm	30 ²	30
- stage 2.....Nm	60	65
- stage 3.....Nm	+ 90°	+ 90°
- stage 4.....Nm	+ 90°	+ 90°
- stage 5.....Nm	—	—
- stage 6.....Nm	—	—
Big-end bearings.....Nm	48 N Bolts: 20 N	48 N
Main bearings.....Nm	112	112
Crankshaft pulley bolt.....Nm	63	63 + 90°
Camshaft pulley bolt.....Nm	20	20 + 90°
Flywheel [driveplate] bolt.....Nm	103	15 + 90° N
Front hubs.....Nm	181 N	250
Rear hubs.....Nm	181 N	185
Wheel nuts / bolts.....Nm	110	110
Glow plugs.....Nm	20	20
Clutch pressure plate bolts.....Nm	19	26
Injection pump sprocket.....Nm	—	60
Injectors.....Nm	25	25
Injection pump mounting bolts.....Nm	—	25
Injector pipe unions.....Nm	20	20

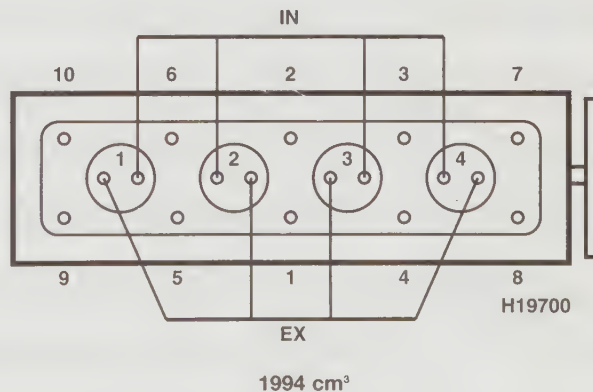
Capacities

Engine oil & filter.....litres	4.0	5.0
Gearbox.....litres	2.0	2.2
Automatic transmission.....litres	—	—
Final drive.....litres	WT	WT
Cooling system.....litres	7.0	7.0
Fuel tank.....litres	55	65

Notes

Civic 2.0 TDi 1997 to 2000

²20T2N: Intercooled

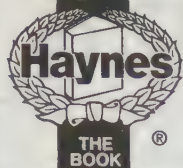
³Bolt length: ≤ 243.41 mm


— Not applicable, or information not available



HYUNDAI

	H100 2.5 D 1997 to 2000			
Engine				
Engine type/code	D4BA SOHC 56kW			
Capacity (cm ³) / cylinders	2477 / 4			
Compression ratio / pressure	21.0 / ≥19.2			
Torque output	Nm 149			
Oil pressureidle [running] bar	—			
Oil temperature°C	—			
Valve clearances - inlet (mm)	0.25 H			
- exhaust (mm)	0.25 H			
Injection order	1-3-4-2			
No. 1 cylinder position	TBE			
Cooling system				
Thermostat opening temperature°C	82			
Radiator cap pressurebar	0.75 to 1.05			
Fuel system				
Idle speedrpm	750 ± 30			
Maximum (no load) speedrpm	5200			
Smoke test/opacityM ⁻¹ %	2.5			
Static timing method	Rotor lift			
Timing dimension.....mm	1.0			
Crankshaft positionmm [°]	[4°] ATDC			
Turbo type / ref / pressure	—			
Injection pump make	Lucas			
Injection pump part no.....	—			
Injector Make / type	Throttle type			
Injector part no.....	—			
Injection type.....	Indirect			
Injection opening pressure, New [used]...bar	120 to 130			
Glow plugs				
Maker	Beru			
Type	GN955			
Nominal rating.....V/A	—			
Brakes				
minimum friction material thickness				
Front.....mm	2.0			
Rear.....mm	1.0			
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185x14			
Pressure - front / rear - Saloon / Hatch...bar	—			
- Estate / Vanbar	3.0 / 3.0			
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.0 to 3.0			
Camber	0°30' ± 45'			
Castor	3° ± 1°			
King pin inclination.....	—			
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	—			
Camber	—			



HYUNDAI

H100 2.5 D
1997 to 2000

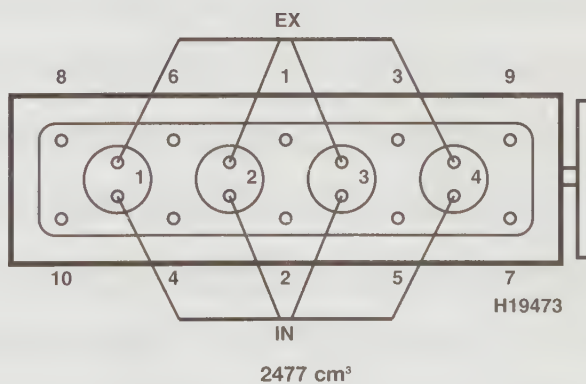
Torque wrench settings

Cylinder head - stage 1	Nm	105		
- stage 2	Nm	-		
- stage 3	Nm	-		
- stage 4	Nm	-		
- stage 5	Nm	-		
- stage 6	Nm	-		
Big-end bearings	Nm	46 N		
Main bearings	Nm	80		
Crankshaft pulley bolt	Nm	-		
Camshaft pulley bolt	Nm	-		
Flywheel [driveplate] bolt	Nm	135		
Front hubs	Nm	WSM		
Rear hubs	Nm	WSM		
Wheel nuts / bolts	Nm	130		
Glow plugs	Nm	-		
Clutch pressure plate bolts	Nm	20		
Injection pump sprocket	Nm	-		
Injectors	Nm	55		
Injection pump mounting bolts	Nm	-		
Injector pipe unions	Nm	-		

Capacities

Engine oil & filter	litres	5.2		
Gearbox	litres	2.1		
Automatic transmission	litres	-		
Final drive	litres	1.2		
Cooling system	litres	8.7		
Fuel tank	litres	55		

Notes

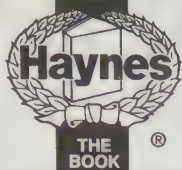


- Not applicable, or information not available



ISUZU

	Trooper 2.8 (UBS55) 1988 to 1992	Trooper 2.8 Turbo (UBS55-J) 1988 to 1992	Trooper 2.8 Turbo 1989 to 1992	Trooper 3.0 TD 1998 to 2000
Engine				
Engine type/code.....	4JB1 OHV 64kW	4JB1T OHV Turbo 71kW	4JB1TC + EGR OHV 78kW	4JX1 DOHC 16V Turbo 116kW
Capacity (cm ³) / cylinders.....	2771 / 4	2771 / 4	2771 / 4	2999 / 4
Compression ratio / pressurebar	18.2 / ≥30.4	17.5 / ≥30.4	17.5 / ≥30.4	19.0 / ≥21.5
Torque outputNm	0	0	0	331
Oil pressureIdle [running] bar	[3.9 to 4.9]	[3.9 to 4.9]	[3.9 to 4.9]	[3.9]
Oil temperature°C	50	50	50	80
Valve clearances - inlet (mm)	0.40	0.40	0.40	0.15
- exhaust (mm)	0.40	0.40	0.40	0.25
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	F	F	F	TBE
Cooling system				
Thermostat opening temperature°C	82	82	82	83
Radiator cap pressurebar	0.9 to 1.2	0.9 to 1.2	0.9 to 1.2	0.8 to 1.1
Fuel system				
Idle speedrpm	750 to 790 A/C: 900	750 to 790 A/C: 900	750 to 790	720 ± 30
Maximum (no load) speedrpm	-	4400 to 4800	4400 to 4800	-
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	3.0
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	-
Timing dimension.....mm	0.50	0.50	0.50	-
Crankshaft positionmm [°]	[12]	[12] Belt drive: [10]	[12] Belt drive: [10]	-
Turbo type / ref / pressurebar	-	-	-	IHI RHF5
Injection pump make	Diesel Kiki	Bosch	Bosch	-
Injection pump part no.....	-	9460 610 315	-	-
Injector Make / type.....	4 hole	Bosch	-	-
Injector part no.....	DN12SD12T or EF8511/9	DN12SD12T or EF8511/9	DN12SD12T or EF8511/9	-
Injection type.....	Bosch VE type	Zexel VE4	Zexel Direct VE4	Direct common rail ¹
Injection opening pressure, New [used]...bar	185	185 ¹	185 ¹	350 to 1000
Glow plugs				
Maker	Bosch	Bosch	-	-
Type	0250 202 065	0250 202 065	-	-
Nominal rating.....V/A	5.0 / 11.1	5.0 / 11.1	5.0 / 11.1	-
Brakes				
minimum friction material thickness				
Front.....mm	1.0	1.0	1.0	-
Rear.....mm	1.0	1.0	1.0	-
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	215x15	215x15	215x15	245/70x16
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	1.8 / 1.8	1.8 / 1.8	1.8 / 1.8	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 to 4.0	0 to 4.0	0 to 4.0	-
Camber	30' ± 30'	30' ± 30'	30' ± 30'	-
Castor	2°30' ± 45'	2°30' ± 45'	2°30' ± 45'	-
King pin inclination.....	10° ± 1°	10° ± 1°	10° ± 1°	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-	-	-
Camber	-	-	-	-



ISUZU

	Trooper 2.8 (UBS55) 1988 to 1992	Trooper 2.8 Turbo (UBS55-J) 1988 to 1992	Trooper 2.8 Turbo 1989 to 1992	Trooper 3.0 TD 1998 to 2000
Torque wrench settings				
Cylinder head - stage 1.....Nm	49 ± 5	49 ± 5	49 ± 5	49
- stage 2.....Nm	+ 60°	+ 60°	+ 60°	+ 60°
- stage 3.....Nm	+ 60°	+ 60°	+ 60°	+ 60°
- stage 4.....Nm	-	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	83 ± 5 N	83 ± 5 N	83 ± 5 N	29 + 50° N
Main bearings.....Nm	166 ± 10	166 ± 10	166 ± 10	167
Crankshaft pulley bolt.....Nm	186 ± 17	186 ± 17	186 ± 17	WSM
Camshaft pulley bolt.....Nm	108 ± 10	108 ± 10	108 ± 10	40 + 80°
Flywheel [driveplate] bolt.....Nm	117 ± 5	117 ± 5	117 ± 5	59 + 75°
Front hubs.....Nm	WSM	WSM	WSM	-
Rear hubs.....Nm	WSM	WSM	WSM	-
Wheel nuts / bolts.....Nm	Steel: 78 to 118 ¹	Steel: 78 to 118 ²	Steel: 78 to 118 ²	-
Glow plugs.....Nm	22 ± 2	22 ± 2	22 ± 2	15
Clutch pressure plate bolts.....Nm	16 to 20	16 to 20	16 to 20	-
Injection pump sprocket.....Nm	64 ± 5	64 ± 5	64 ± 5	10
Injectors.....Nm	32 to 44	32 to 44	32 to 44	30
Injection pump mounting bolts.....Nm	19 ± 5	19 ± 5	19 ± 5	-
Injector pipe unions.....Nm	20 to 40	20 to 40	20 to 40	80
Capacities				
Engine oil & filter.....litres	4.3	4.3	4.3	6.0
Gearbox.....litres	2.95 ²	2.95 Transfer: 1.45	2.95 Transfer: 1.45	-
Automatic transmission.....litres	4.5 ³	4.5 Transfer: 0.8	4.5 Transfer: 0.8	-
Final drive.....litres	Front: 1.5 ⁴	Front: 1.5 Rear: 1.8	Front: 1.5 Rear: 1.8	-
Cooling system.....litres	10.3	10.3	10.3	5.8
Fuel tank.....litres	83	83	83	85

Notes

Trooper 2.8 (UBS55) 1988 to 1992

¹Alloy: 108 to 127

²Transfer box: 1.45

³Transfer box: 0.8

⁴Rear: 1.8

Trooper 2.8 Turbo (UBS55-J) 1988 to 1992

¹Belt drive, two spring type: 1st pressure: 175, 2nd pressure: 275

²Alloy: 108 to 127

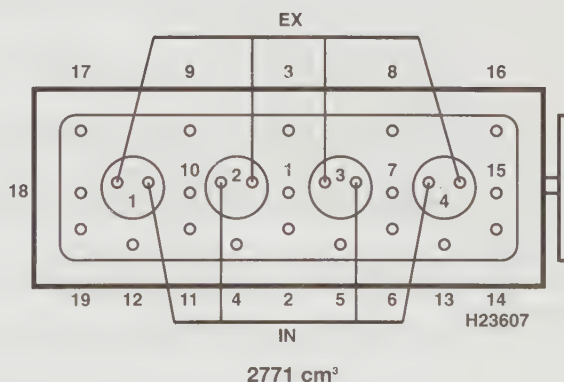
Trooper 2.8 Turbo 1989 to 1992

¹Two spring type: 1st pressure: 175. 2nd pressure: 275

²Alloy: 108 to 127

Trooper 3.0 TD 1998 to 2000

¹Caterpillar system.





ISUZU

Trooper 3.1 TD 1992 to 1998

Engine

Engine type/code	4JG2TC OHV Turbo 84kW
Capacity (cm ³) / cylinders	3059 / 4
Compression ratio / pressure	20.0 / 30.4 bar
Torque output	260 Nm
Oil pressureidle [running] bar	-
Oil temperature°C	-
Valve clearances - inlet (mm)	0.40
- exhaust (mm)	0.40
Injection order	1-3-4-2
No. 1 cylinder position	-

Cooling system

Thermostat opening temperature°C	74
Radiator cap pressure	0.9 to 1.2 bar

Fuel system

Idle speedrpm	720
Maximum (no load) speedrpm	4250
Smoke test/opacityM ⁻¹ %	2.5
Static timing method	Plunger travel
Timing dimension.....mm	0.5
Crankshaft positionmm [°]	TDC
Turbo type / ref / pressure	-
Injection pump make	Bosch
Injection pump part no.....	VE
Injector Make / type	-
Injector part no.....	-
Injection type.....	Indirect
Injection opening pressure, New [used]...bar	147

Glow plugs

Maker	-
Type	-
Nominal rating.....V/A	-

Brakes

minimum friction material thickness	
Front.....mm	1.0
Rear.....mm	1.0

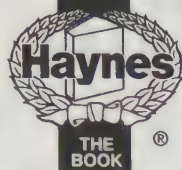
Tyres - Saloon / Hatch.....Size	-
- Estate / Van.....Size	245/70x16
Pressure - front / rear - Saloon / Hatch...bar	-
- Estate / Vanbar	2.1 / 2.3

Front suspension / wheel alignment

Toe-in (+) / Toe-out (-).....mm [°]	0.0 ± 2.0
Camber	0° ± 30'
Castor	2°10' ± 45'
King pin inclination.....	-

Rear suspension / wheel alignment

Toe-in (+) / Toe-out (-).....mm [°]	0
Camber	0



ISUZU

Trooper 3.1 TD 1992 to 1998

Torque wrench settings

Cylinder head - stage 1	Nm	49
- stage 2	Nm	+ 75°
- stage 3	Nm	+ 75°
- stage 4	Nm	-
- stage 5	Nm	-
- stage 6	Nm	-
Big-end bearings	Nm	29 + 50° N
Main bearings	Nm	167
Crankshaft pulley bolt	Nm	275
Camshaft pulley bolt	Nm	118
Flywheel [driveplate] bolt	Nm	118
Front hubs	Nm	-
Rear hubs	Nm	-
Wheel nuts / bolts	Nm	118
Glow plugs	Nm	23
Clutch pressure plate bolts	Nm	18
Injection pump sprocket	Nm	64
Injectors	Nm	64
Injection pump mounting bolts	Nm	20
Injector pipe unions	Nm	29

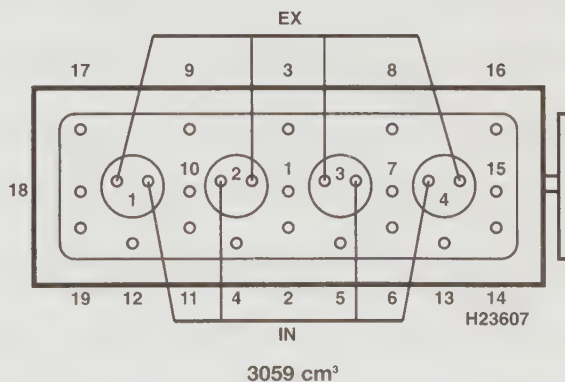
Capacities

Engine oil & filter	litres	6.0
Gearbox	litres	2.95
Automatic transmission	litres	-
Final drive	litres	1.8 Front: 1.5 ¹
Cooling system	litres	8.6
Fuel tank	litres	85

Notes

Trooper 3.1 TD 1992 to 1998

¹Transfer: 1.45



- Not applicable, or information not available



LANCIA

	Delta & Prisma 1.9 Turbo 1986 to 1993	Prisma 1.9 1986 to 1991	Dedra 1.9 Turbo D 1990 to 1998	Thema Turbo DS 1989 to 1992
Engine				
Engine type/code	631 D1.300 SOHC Turbo 59kW	831 D.000 48kW	835 A4.000 SOHC Turbo 66kW	8144.97 SOHC Turbo 85kW
Capacity (cm ³) / cylinders	1929 / 4	1929 / 4	1929 / 4	2499 / 4
Compression ratio / pressure	20.3±0.5 / _	21.0±0.5 / _	19.2 ± 0.5 / _	21.0 / _
Torque output	0	0	0	0
Oil pressureidle (running) bar	[3.4 to 4.9]	[3.4 to 4.9]	[3.4 to 4.9]	0.78 [3.9]
Oil temperature	100	100	100	100
Valve clearances - inlet (mm)	0.30 ± 0.05	0.30 ± 0.05	0.30 ± 0.05	0.50 ± 0.05
- exhaust (mm)	0.35 ± 0.05	0.35 ± 0.05	0.35 ± 0.05	0.50 ± 0.05
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. of cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature °C	78 to 82	78 to 82	78 to 82	77 to 81
Radiator cap pressure	0.78	0.78	0.78	0.78
Fuel system				
Idle speed	780 ± 20	780 ± 20	830 ± 20	800 to 850
Maximum (no load) speed	4800 ± 40	5180 ± 40	4900 ± 40	4950
Smoke test opacityM-1 %	2.5	2.5	2.5	2.5
Static timing method	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension	1.0	0.88	0.8	1.0
Crankshaft position	[0] TDC	[0] TDC	[0] TDC	[0] TDC
Turbo type / ref / pressure	-	-	-	-
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.	0460 494 163	-	0460 494 250	046 404 059
Injector Make / type	Bosch	Bosch	Bosch	Bosch
Injector part no.	DN12 SD 1750	DN12 SD 1750	DNO SD 290	DNO SD 259
Injection type	VE 4.9F 2100 L184	VE 4.9F 2300 L157	VER 303-1	VER 318
Injection opening pressure, New [used]...bar	150 to 158	125 to 133	150 to 158	150 to 158
Glow plugs				
Maker	Marelli/Bosch	Marelli/Bosch	Marelli/Bosch	Beru
Type	UX2A / 0250 201 005	UX2A / 0.250.201.005	UX2A / 0250 201 005	0100 221 167
Nominal rating	11 / 12	-	11 / 12	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.5	1.5	1.5
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size	165/65x14	165/65x14	175/65x14; 185/60x14	185/70x14; 195/60x14
- Estate / Van.....Size	-	-	-	185/70x14; 195/65x14
Pressure - front / rear - Saloon / Hatch...bar	2.3 / 2.0	2.3 / 2.0	2.3 / 2.1	2.2 / 2.2
- Estate / Van.....bar	-	-	-	2.3 / 2.4
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 to -2.5	1.0 to -2.5	-1.0 to 1.0	-1.0 to 1.0
Camber	1°0' ± 30'	1°0' ± 30' N/A	1°0' ± 30'	-4°0' to 0°
Castor	2°40' ± 30'	2°40' ± 30' N/A	2°40' ± 30'	2°30' to 3°10'
King pin inclination.....	9°18'	9°18'	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 to 5.0	2.0 to 5.0	-2.5 to 1.5	2.0 to 5.0
Camber	-2°0' ± 30'	-2°0' ± 30' N/A	-1°30' ± 30'	-4°0' to 0°



LANCIA

Delta & Prisma 1.9 Turbo
1986 to 1993

Prisma 1.9
1986 to 1991

Dedra 1.9 Turbo D
1990 to 1998

Thema Turbo DS
1989 to 1992

Torque wrench settings

Cylinder head - stage 1	Nm	50	50	50	40
- stage 2	Nm	100	100	100	Slacken, then 40
- stage 3	Nm	+ 90°	+ 90°	+ 90°	+ 180°
- stage 4	Nm	+ 90°	+ 90°	+ 90°	-
- stage 5	Nm	-	-	M8 bolts: 30	-
- stage 6	Nm	-	-	-	-
Big-end bearings.....	Nm	25 + 50° N	25 + 50°	25 + 50° N	115 N
Main bearings.....	Nm	113	113	113	78 then 157
Crankshaft pulley bolt	Nm	190	190	190	-
Camshaft pulley bolt	Nm	118	118	118	25
Flywheel [driveplate] bolt.....	Nm	142	142	142	125
Front hubs	Nm	294	294	280	360
Rear hubs	Nm	216	216	320	320
Wheel nuts / bolts	Nm	86	86	86	88
Glow plugs	Nm	15	15	15	37
Clutch pressure plate bolts	Nm	38	38	38	20
Injection pump sprocket.....	Nm	50	50	49	25
Injectors.....	Nm	78	78	55	35
Injection pump mounting bolts	Nm	25	25	25	25
Injector pipe unions.....	Nm	32	32	32	-

Capacities

Engine oil & filter.....	litres	5.0	5.0	5.0	6.4
Gearbox.....	litres	3.2	3.2	1.4	1.8 to 2.1
Automatic transmission	litres	-	-	-	-
Final drive	litres	WT	WT	WT	WT
Cooling system.....	litres	7.0	7.0	8.9	9.0
Fuel tank.....	litres	57	57	63	70

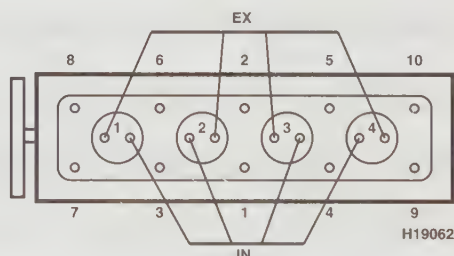
Notes

Delta & Prisma 1.9 Turbo 1986 to 1993

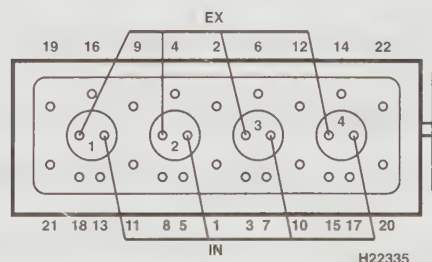
¹Prisma PAS: 3°25'±30'

Prisma 1.9 1986 to 1991

¹Prisma PAS: 3°25'±30' N/A

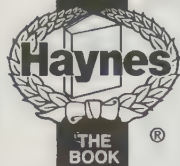


1929 cm³



2499 cm³

- Not applicable, or information not available



	Kappa 2.4 TD 1995 to 1998	Zeta 2.1 TD 1996 to 1999		
Engine				
Engine type/code.....	838 A3.000 10V 91kW	XUD11 P8C SOHC Turbo 80kW		
Capacity (cm ³) / cylinders.....	2387 / 5	2088 / 4		
Compression ratio / pressurebar	21.0 / _	21.5 /		
Torque outputNm	0	250		
Oil pressureidle [running] bar	[5.0 @ 4000]	[4.9]		
Oil temperature°C	100	80		
Valve clearances - inlet (mm)	0.30 ± 0.05	0: Hyd.		
- exhaust (mm)	0.35 ± 0.05	0: Hyd.		
Injection order.....	1-2-4-5-3	1-3-4-2		
No. 1 cylinder position	TBE	F		
Cooling system				
Thermostat opening temperature°C	-	-		
Radiator cap pressurebar	0.98	-		
Fuel system				
Idle speedrpm	830 to 870	690 ± 25		
Maximum (no load) speedrpm	5150	-		
Smoke test/opacityM ⁻¹ %	1.6	2.5		
Static timing method.....	Plunger travel	Refer to wsm		
Timing dimension.....mm	0.65	-		
Crankshaft positionmm [°]	TDC	-		
Turbo type / ref / pressurebar	-	-		
Injection pump make	Bosch	Lucas		
Injection pump part no.....	VER 560	EPIC		
Injector Make / type.....	Bosch	-		
Injector part no.....	KCA SV0216 138	-		
Injection type.....	Indirect	EPIC		
Injection opening pressure, New [used]...bar	150 to 158	150		
Glow plugs				
Maker	Bosch	Bosch		
Type	0281 003 010	0250 201 033		
Nominal rating.....V/A	-	11 / 9		
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.5		
Rear.....mm	1.5	1.5		
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185/65x14; 195/60x14	-		
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.2	-		
- Estate / Vanbar	2.3 / 2.4	-		
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.0 to 1.0	-		
Camber	-40' to 0°	-		
Castor	2°30' to 3°10'	-		
King pin inclination.....	-	-		
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 to 4.0'	-		
Camber	-40' to 0°	-		



LANCIA

Kappa 2.4 TD
1995 to 1998

Zeta 2.1 TD
1996 to 1999

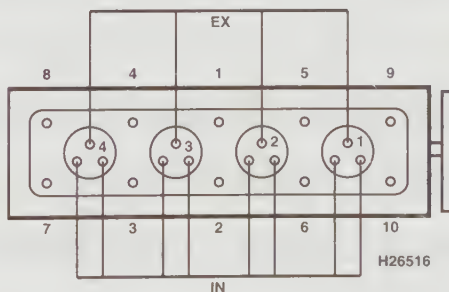
Torque wrench settings

Cylinder head - stage 1.....Nm	60	35
- stage 2.....Nm	+ 90°	70 + 150°
- stage 3.....Nm	+ 90°	warm up, allow to cool
- stage 4.....Nm	+ 90°	slacken
- stage 5.....Nm	-	70
- stage 6.....Nm	-	+ 150°
Big-end bearings.....Nm	25 + 50° N	70 N
Main bearings.....Nm	113	60
Crankshaft pulley bolt.....Nm	360	70 + 60°
Camshaft pulley bolt.....Nm	118	45
Flywheel [driveplate] bolt.....Nm	142	50
Front hubs.....Nm	360	300
Rear hubs.....Nm	320	-
Wheel nuts / bolts.....Nm	98	-
Glow plugs.....Nm	15	23
Clutch pressure plate bolts.....Nm	20	15
Injection pump sprocket.....Nm	50	50
Injectors.....Nm	55	90
Injection pump mounting bolts.....Nm	25	20
Injector pipe unions.....Nm	-	-

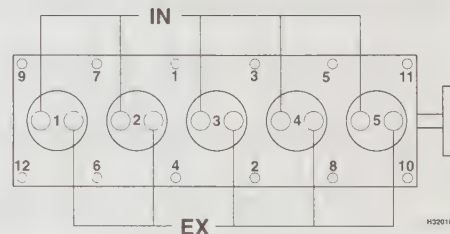
Capacities

Engine oil & filter.....litres	5.5	4.75
Gearbox.....litres	2.3	1.85
Automatic transmission.....litres	4.4	-
Final drive.....litres	WT	WT
Cooling system.....litres	8.2	9.0
Fuel tank.....litres	65	-

Notes



2088 cm³



2387 cm³

- Not applicable, or information not available



LAND ROVER

	90 & 110 2.5 Turbo 1986 to 1992	Defender 200TDi 1990 to 1994	Defender 90, 110 300TDi 1994 to 2000	Freelander 2.0 TDi 1997 to 2000
Engine				
Engine type/code	12J OHV Turbo 63kW	200TDi OHV Turbo 79kW	300TDi OHV Turbo 82kW	L Series SOHC TDi EGR 88kW
Capacity (cm ³) / cylinders	2495 / 4	2495 / 4	2495 / 4	1994 / 4
Compression ratio / pressurebar	21.0 / _	19.5 ± 0.5 / _	19.5 /	19.5 /
Torque outputNm	0	0	265	210
Oil pressureidle [running] bar	[2.4 to 4.5]	[1.7 to 3.8]	1.7 to 3.8	0.7 [3.8]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.25	0.20	0.20	0: Hyd.
- exhaust (mm)	0.25	0.20	0.20	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	F	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	82	88	88	80 to 84
Radiator cap pressurebar	1.0	1.04	1.0	0.9 to 1.2
Fuel system				
Idle speedrpm	650 ± 20	780 to 800	720 ± 20	850 ± 50'
Maximum (no load) speedrpm	4400 ± 80	4100 to 4260	4490	5300
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.0	2.0
Static timing method	Refer to wsm	Plunger travel	Plunger travel	-
Timing dimension.....mm	-	1.54	1.54	Computer controlled
Crankshaft positionmm [°]	-	TDC	TDC	-
Turbo type / ref / pressurebar	-	-	Allied signal	Garrett GT 1549
Injection pump make	CAV	Bosch	Bosch	Bosch
Injection pump part no.....	-	1900R 347-1	R509	VP37
Injector Make / type	CAV	Bosch	Bosch	-
Injector part no.....	BDNO/SPC 6209	DSLA 145P208	DSLA 145P366	-
Injection type.....	DPS	VE4/11F	VER	EDC Two stage
Injection opening pressure, New [used]...bar	135	203 to 284	200 to 300	200 to 320
Glow plugs				
Maker	Champion	Bosch	Bosch	Beru
Type	CH63	0250 201 012	0250 201 012	0100226 184
Nominal ratingV/A	11 / 8.5	11.0 / _	-	-
Brakes				
minimum friction material thickness				
Front.....mm	-	-	-	3.0
Rear.....mm	-	-	-	2.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	-	-	-	-
Pressure - front rear - Saloon / Hatch...bar	6.00x16; 7.50x16; 205x16	205x16; 750x16	Refer to vehicle	195/80x15; 215/65x16
- Estate / Van.....bar	-	-	-	-
	Refer to manufacturer / OHB	Refer to manufacturer / OHB	Refer to vehicle	2.1 / 2.1; 2.1 / 2.1
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.2 to 2.4'	1.2 to 2.4'	0.0 to -2.0	[-0°10' ± 15']
Camber	0	0	0.0	-0°15' ± 45'
Castor	3°	3°	3.0	3°30' ± 1°
King pin inclination.....	7°	7°	-	12°18'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-	-	[20' ± 15']
Camber	-	-	-	-0°30' ± 45'



LAND ROVER

	90 & 110 2.5 Turbo 1986 to 1992	Defender 200TDi 1990 to 1994	Defender 90, 110 300TDi 1994 to 2000	Freelander 2.0 TDi 1997 to 2000
Torque wrench settings				
Cylinder head - stage 1.....Nm	115 to 130	40	40	30
- stage 2.....Nm	-	+ 60°	+ 60°	65
- stage 3.....Nm	-	+ 60°	+ 60°	+ 90°
- stage 4.....Nm	-	-	M12: + 20°	+ 90°
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	34 to 46 N	56 to 62 N	59 N	20 + 85° N
Main bearings.....Nm	130 to 136	130 to 136	133	112
Crankshaft pulley bolt.....Nm	260 to 280	335 to 350	343	63 + 90°
Camshaft pulley bolt.....Nm	40 to 50	40 to 50	80	20 + 90°
Flywheel [driveplate] bolt.....Nm	130 to 143	139 to 153	145	15 + 90° N
Front hubs.....Nm	-	-	WSM	400 N
Rear hubs.....Nm	-	-	WSM	400 N
Wheel nuts / bolts.....Nm	108	108	108	115
Glow plugs.....Nm	34	15 to 30	20	20
Clutch pressure plate bolts.....Nm	25 to 34	30 to 38	34	25
Injection pump sprocket.....Nm	-	22 to 28	-	20 + 90°
Injectors.....Nm	22 to 28	20 to 25	25	25
Injection pump mounting bolts.....Nm	22 to 28	22 to 28	25	-
Injector pipe unions.....Nm	-	22 to 25	25	28
Capacities				
Engine oil & filter.....litres	6.9	6.9	6.85	4.5
Gearbox.....litres	2.2 ²	2.2 ²	2.6 Transfer: 28	2.0
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	1.7 ³	1.7 ³	F: 1.7 R: 2.3	Rear: 0.8
Cooling system.....litres	11.0	11.1	11.1	6.5
Fuel tank.....litres	79.5 ⁴	79.5 ⁴	90: 54 110: 80	59

Notes

90 & 110 2.5 Turbo 1986 to 1992

¹Permanent 4 wheel drive: figures are toe-out (-)

²Transfer box: 2.8

³Rear, 90: 1.7, 110: 2.3

⁴Rear tank only. Side tank: 68.2. Station Wagon side tank: 45.5. 90: 54.5

Defender 200TDi 1990 to 1994

¹Permanent 4 wheel drive: -1.2 to -2.4

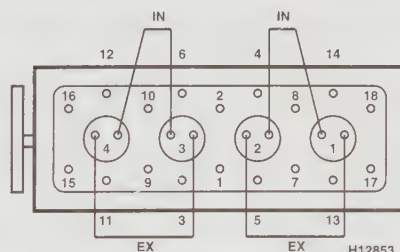
²Transfer box: 2.3

³Rear, 90: 1.7, 110: 2.3

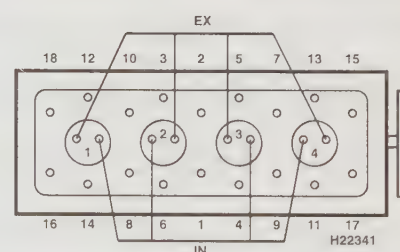
⁴Rear tank only. Side tank: 68.2. Station Wagon side tank: 45.5. 90: 54.5

Freelander 2.0 TDi 1997 to 2000

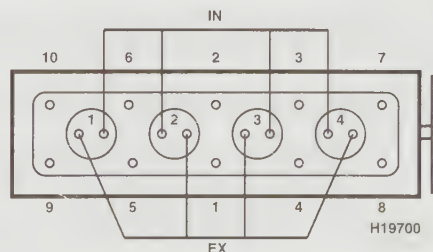
⁵With A/C on: 875 ± 50



2495 cm³



Defender 2495 cm³



1994 cm³

- Not applicable, or information not available



LAND ROVER

	Discovery 200TDi 1989 to 1994	Discovery 300TDi 1995 to 1998	Discovery TD5 1998 to 2000	Range Rover 2.4 TD 1986 to 1992
Engine				
Engine type/code	200TDi OHV Turbo 82kW	300TDi OHV Turbo 82kW	TD5 SOHC	11A VM HR 492 HI OHV 84kW
Capacity (cm ³) / cylinders	2495 / 4	2495 / 4	2498 / 5	2393 / 4
Compression ratio / pressure	19.5 ± 0.5 / _	19.5 / _	19.5 /	21.5 ± 0.5 / _
Torque output	0	265	0	0
Oil pressureidle [running] bar	[1.7 to 3.8]	[1.7 to 3.8]	[1.5 to 3.0]	[3.5 to 3.9]
Oil temperature °C	80	80	80	90 to 100
Valve clearances - inlet (mm)	0.20	0.20	0: Hyd.	0.30
- exhaust (mm)	0.20	0.20	0: Hyd.	0.30
Injection order	1-3-4-2	1-3-4-2	1-2-4-5-3	1-3-4-2
No. 1 cylinder position	TBE	TBE	-	F
Cooling system				
Thermostat opening temperature °C	82	88	82	83 ± 2
Radiator cap pressure bar	1.04	1.04	1.4	1.04
Fuel system				
Idle speedrpm	720 ± 20	720 ± 20	740 ± 50 [760 ± 50]	750 to 800
Maximum (no load) speedrpm	4600 +40 -120	4600 ± 40	4850	4700 to 4730
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method	Plunger travel	Plunger travel	-	Plunger travel
Timing dimension.....mm	1.54	1.54	Computer controlled	0.5
Crankshaft positionmm [°]	TDC	TDC	-	[4]
Turbo type / ref / pressurebar	-	0.8 to 1.0 bar @ 3000rpm	Garrett GT20	-
Injection pump make	Bosch	Bosch	-	Bosch
Injection pump part no.	0460 414 069	VE4/11F	-	168-1
Injector Make / type	Bosch	Bosch	-	Bosch
Injector part no.	BDNO/SPC 6209	DSLA 14SP 366	-	DN OSD 263
Injection type.....	VE4/11F	R509	Direct Injection	Rotary VE4/10F L
Injection opening pressure, New [used]...bar	203 to 284	200	1500	150 +8 -0
Glow plugs				
Maker	Beru	Beru	Beru	Bosch
Type	783 MJ	0 100 226 129A	-	0250 201 012
Nominal ratingV/A	11.0 / _	-	-	11.0 / 10.5
Brakes				
minimum friction material thickness				
Front.....mm	-	-	2.0	-
Rear.....mm	-	-	2.0	-
Tyres - Saloon / HatchSize				
- Estate / Van.....Size	205x16	205x16 : 235x70 R16	235/70x16: 225/65x16:255/55x18	205x16: 215/75x16
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	1.9 / 2.6	1.9 / 2.6 : 1.8 / 2.4	1.9 / 2.5	1.9 / 2.1
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.2 to -2.4	[0° to 16°]	[0°5' ± 2.5°]	-1.2 to -2.4
Camber	0	0°	0°	0
Castor	3°	3°	3.6° to 3.8°	3°
King pin inclination.....	7°	7°	13°	7°
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-	-	-
Camber	-	-	-	-



LAND ROVER

Discovery 200TDi
1989 to 1994

Discovery 300TDi
1995 to 1998

Discovery TD5
1998 to 2000

Range Rover 2.4 TD
1986 to 1992

Torque wrench settings

Cylinder head - stage 1	Nm 40	40	30	No 1 to 10: 5 to 10
- stage 2	Nm + 60°	+ 60°	65	No 1 to 10: 30
- stage 3	Nm + 60°	+ 60°	+ 90°	No 1 to 10: + 50°
- stage 4	Nm -	M12: + 20°	+ 180°	No 1 to 10: + 50°
- stage 5	Nm -	-	+ 45°	No 11: 90
- stage 6	Nm -	-	-	1
Big-end bearings	Nm 56 to 62 N	59 N	20 N	79 to 83
Main bearings	Nm 130 to 136	133	33 + 90°	41 to 43 ²
Crankshaft pulley bolt	Nm 335 to 350	80 + 90°	455	146 to 157
Camshaft pulley bolt	Nm 40 to 50	40 to 50	37	30
Flywheel [driveplate] bolt	Nm 139 to 153	146	40 + 90°	108
Front hubs	Nm -	WSM	490	41 to 52
Rear hubs	Nm -	WSM	490	41 to 52
Wheel nuts bolts	Nm 129	126	140	Steel: 102 to 115 ³
Glow plugs	Nm 15 to 30	20	16	23
Clutch pressure plate bolts	Nm 30 to 38	34	25	24 to 30
Injection pump sprocket	Nm 22 to 28	25	-	88
Injectors	Nm 20 to 25	25	-	24 to 30
Injection pump mounting bolts	Nm 22 to 28	25	-	30 to 31
Injector pipe unions	Nm 22 to 25	29	-	19

Capacities

Engine oil & filter	litres 6.9	6.65	7.2	8.0
Gearbox	litres 2.7 Transfer: 2.8	2.67 Transfer: 2.8	2.3 to 2.8 Transfer: 2.0	2.7 ⁴
Automatic transmission	litres -	9.1	9.1	-
Final drive	litres Front & rear: 1.7	Front & rear: 1.7	1.6	Front & rear: 1.7
Cooling system	litres 11.5	11.5	8.0	11.5
Fuel tank	litres 88.6	89	95	80

Notes

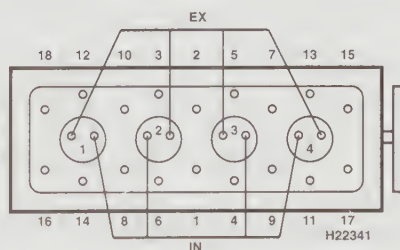
Range Rover 2.4 TD 1986 to 1992

¹Run engine for 20 minutes & allow to cool, then no 1 to 10: + 30°. After 40000km: + 10°

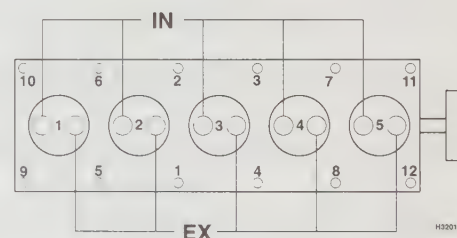
²Rear carrier nuts: 24 to 30

³Alloy: 122 to 129

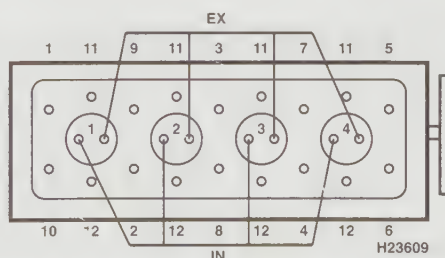
⁴Transfer box: 2.5. 89 ►: 2.1



2495 cm³



2498 cm³



2393 cm³

– Not applicable, or information not available



LAND ROVER

	Range Rover 2.5 Turbo Diesel 1989 to 1992	Range Rover 2.5 TDi 1993 to 1994	Range Rover 2.5 TDi 1994 to 1995	Range Rover 2.5 TD 1994 to 1999
Engine				
Engine type/code.....	95 A VM HR 4924 HI OHV 82kW	200TDI OHV Turbo 82kW	300TDI OHV Turbo 82kW	SOHC Turbo 100kW
Capacity (cm ³) / cylinders.....	2500 / 4	2495 / 4	2495 / 4	2497 / 6
Compression ratio / pressure.....bar	22.5 ± 0.5 / 23.5	19.5 /	19.5 /	22.6 / ≤ 20.0
Torque output.....Nm	0	0	0	270
Oil pressure.....idle [running] bar	[3.5 to 3.9]	1.7 to 3.8	1.7 to 3.8	2.0
Oil temperature.....°C	90 to 100	80	80	80
Valve clearances - inlet (mm).....	0.30	0.20	0.20	0: Hyd.
- exhaust (mm).....	0.30	0.20	0.20	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-5-3-6-2-4
No. 1 cylinder position.....	F	-	-	-
Cooling system				
Thermostat opening temperature.....°C	80 ± 2	-	-	80
Radiator cap pressure.....bar	1.04	-	-	1.0
Fuel system				
Idle speed.....rpm	750 to 800	720 ± 20	720 ± 20	750 ± 50
Maximum (no load) speed.....rpm	4700 to 4730	4600	4600	4950 ± 150
Smoke test/opacity.....M ⁻¹ %	3.0	2.0	2.0	2.5
Static timing method.....	-	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	-	1.54	1.54 ¹	0.95 ± 0.02
Crankshaft position.....mm [°]	[3-0+1]	TDC	TDC	TDC
Turbo type / ref / pressure.....bar	-	0.78 bar	0.8 to 1.0 bar	Mitsubishi TD04-11G4
Injection pump make.....	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	2100 L269	VE4/11F R347	VE4/11F R347	R515
Injector Make / type.....	Bosch	Bosch	Bosch	Bosch
Injector part no.....	DNOSN 1510. 90 ►: DNOSD 263	KBEL 98P52	KBEL 98P52	KCA 21S71
Injection type.....	Rotary VE 4/10F	Direct	Direct	Indirect
Injection opening pressure, New [used]...bar	150 +8 -0	200 to 280	100 to 280	140 to 160
Glow plugs				
Maker.....	Bosch	Bosch/Beru	Bosch	Bosch
Type.....	0250 201 012	0250 201 033 / 783 MJ	0250 201 033	0250 201 033
Nominal rating.....V/A	11.0 / -	-	-	-
Brakes				
minimum friction material thickness				
Front.....mm	-	-	-	2.0
Rear.....mm	-	-	-	2.0
Tyres - Saloon / Hatch.....Size	-	-	-	-
- Estate / Van.....Size	205x16: 215/75x16	-	-	234/70x16: 255/70x16
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Van.....bar	1.9 / 2.1	-	-	1.9 / 2.6
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.2 to -2.4	-	-	0.6 to 1.8
Camber.....	0	-	-	0°
Castor.....	3°	-	-	4°
King pin inclination.....	7°	-	-	8°
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-	-	-
Camber.....	-	-	-	-



LAND ROVER

Range Rover 2.5 Turbo Diesel
1989 to 1992

Range Rover 2.5 TDi
1993 to 1994

Range Rover 2.5 TDi
1994 to 1995

Range Rover 2.5 TD
1994 to 1999

Torque wrench settings

Cylinder head - stage 1.....Nm	No 1 to 10: 5 to 10	40	40	80, slacken
- stage 2.....Nm	No 1 to 10: 30	+ 60°	+ 60°	50
- stage 3.....Nm	No 1 to 10: + 50°	+ 60°	+ 60°	+ 90°
- stage 4.....Nm	No 1 to 10: + 50°	-	-	+ 90°
- stage 5.....Nm	No 11: 90	-	-	warm up, allow to cool
- stage 6.....Nm	¹	-	-	+ 90°
Big-end bearings.....Nm	79 to 83	60 N	60 N	20 + 70° N
Main bearings.....Nm	41 to 43 ²	136	136	50 N
Crankshaft pulley bolt.....Nm	146 to 157	340	80 + 90°	100 + 150°
Camshaft pulley bolt.....Nm	-	-	80	20 + 35°
Flywheel [driveplate] bolt.....Nm	108	150	150	105 N [120 N]
Front hubs.....Nm	41 to 52	-	-	260
Rear hubs.....Nm	41 to 52	-	-	WSM
Wheel nuts / bolts.....Nm	Steel: 102 to 115 ³	115 Alloy: 160	130	130
Glow plugs.....Nm	23	30	30	20
Clutch pressure plate bolts.....Nm	24 to 30	30	30	23
Injection pump sprocket.....Nm	88	28	28	47
Injectors.....Nm	24 to 30	25	25	62
Injection pump mounting bolts.....Nm	30 to 31	-	28	23
Injector pipe unions.....Nm	19	25	25	23

Capacities

Engine oil & filter.....litres	8.0	6.8	6.8	9.5
Gearbox.....litres	2.7 ⁴	2.7	2.7	2.7
Automatic transmission.....litres	-	-	-	9.7
Final drive.....litres	Front & rear: 1.7	1.7 Rear: 1.7	1.7 Rear: 1.7	1.7 Rear: 1.7
Cooling system.....litres	11.5	-	-	11.3
Fuel tank.....litres	82	-	-	90

Notes

Range Rover 2.5 Turbo Diesel 1989 to 1992

¹Run engine for 20 minutes & allow to cool, then no 1 to 10: + 30°. After 40000km: + 10°

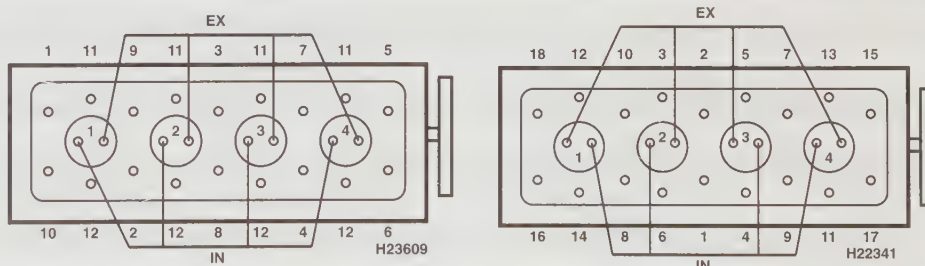
²Rear carrier nuts: 24 to 30

³Alloy: 122 to 129

⁴Transfer box: 2.5. 89 ▶: 2.1

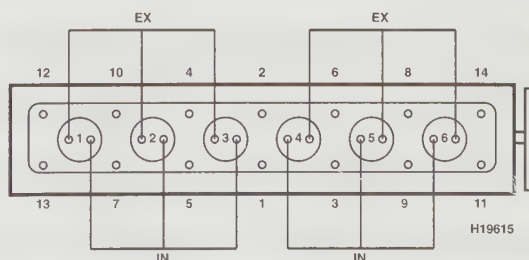
Range Rover 2.5 TDi 1994 to 1995

¹R509/1: 1.4 mm R500: 0.4 mm



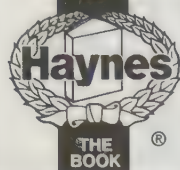
2500 cm³

2495 cm³



2497 cm³

– Not applicable, or information not available



LEYLAND DAF (LDV)

	200 / Pilot 1.9D 1995 to 1998	200 2.0 1989 to 1995	300 2.5 1989 to 1991	300 2.5 Turbo 1989 to 1991
Engine				
Engine type/code	XUD9A SOHC 52kW	TN44 Two stage DI 44kW	PSA EN55	PSA ET70
Capacity (cm ³) / cylinders	1905 / 4	1994 / 4	2498 / 4	2498 / 4
Compression ratio / pressure	23.0 / 25.0 to 30.0	18.0 / 27.6	23.0 / ≥18.0	21.0 / ≥18.0
Torque output	120 Nm	0	0	0
Oil pressureidle [running] bar	[3.5 @ 4000]	1.0 to 1.3	1.6 [3.7]	1.2 [3.7]
Oil temperature°C	80	-	110	80
Valve clearances - inlet (mm)	015 ± 0.05	0.30 ± 0.10	0.15	0.15
- exhaust (mm)	0.30 ± 0.05	0.40 ± 0.10	0.25	0.25
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	F	FE	FE
Cooling system				
Thermostat opening temperature°C	83	88	81	81
Radiator cap pressure	1.0 bar	1.0	0.6	1.0
Fuel system				
Idle speedrpm	800 ± 500	825 ± 25	775 ± 25	775 ± 25
Maximum (no load) speedrpm	5100	5130	4500 ± 75	4750 +50 -100
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Plunger travel	Plunger travel	Refer to text	Refer to text
Timing dimension.....mm	Dimension on pump	1.0 ± 0.03 ¹	Value marked on pump	Value marked on pump
Crankshaft positionmm [°]	-	[0] TDC	2.85	2.85
Turbo type / ref / pressure	-	-	-	-
Injection pump make	Lucas	Bosch	Roto Diesel	Roto Diesel
Injection pump part no.....	DPC 8443B 952B	-	R8443 B600A	R8443 B254C
Injector Make / type	CAV	CAV	Roto Diesel	Roto Diesel
Injector part no.....	RDNOSDC6887D	JB 6801081	RDN OSDC 6577B	RDN 12SDC 6849C
Injection type.....	Indirect	EPVE	DPC Type 059	DPC Type 053
Injection opening pressure, New [used]...bar	120 to 130	N/A	115 ± 5	130 ± 5
Glow plugs				
Maker	Beru	Beru/Bosch/Champion	-	-
Type	GV798	SR-3 / 0250 200 035 / CH32	-	-
Nominal rating.....V/A	11 / 25	12 / 6	-	-
Brakes				
minimum friction material thickness				
Front.....mm	1.0	3.0	3.0	3.0
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size	-	-	-	-
- Estate / Van.....Size	185/14	185x14	185x14: 205x14	185x14: 205x14
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	Owners handbook	Refer to vehicle	Refer to owner's handbook	Refer to owner's handbook
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.6 to 3.2	-1.6 to -3.2	0 to 1.6	0 to 1.6
Camber	2°30'	2°30'	1°30'	1°30'
Castor	5°	3°30'	1° U/L	1° U/L
King pin inclination.....	8°30'	8°30'	9°30'	9°30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-	-	-
Camber	-	-	-	-



LEYLAND DAF (LDV)

	200 / Pilot 1.9D 1995 to 1998	200 2.0 1989 to 1995	300 2.5 1989 to 1991	300 2.5 Turbo 1989 to 1991
Torque wrench settings				
Cylinder head - stage 1Nm	20 N	50	30	30
- stage 2Nm	60	100	70	70
- stage 3Nm	+ 180°	+ 90°	- 90°, then 70	- 90°, then 70
- stage 4Nm	-	-	Run engine, cool for 3.5 hours	Run engine, cool for 3.5 hours
- stage 5Nm	-	-	- 90°, then 70	- 90°, then 70
- stage 6Nm	-	-	+ 120°	+ 120°
Big-end bearings.....Nm	WSM	47 N	60	60
Main bearings.....Nm	35, 70	112	120	120
Crankshaft pulley boltNm	40 + 60°	180	55 + 60°	55 + 60°
Camshaft pulley boltNm	40	85	-	-
Flywheel [driveplate] bolt.....Nm	50	65	15 + 60°	15 + 60°
Front hubsNm	WSM	-	-	-
Rear hubsNm	-	203 to 217	136 to 163	136 to 163
Wheel nuts / boltsNm	90	80	176 to 227 ¹	176 to 227 ¹
Glow plugsNm	22	20	-	-
Clutch pressure plate boltsNm	25	35	20	20
Injection pump sprocket.....Nm	50	60	-	-
Injectors.....Nm	90	43	90	90
Injection pump mounting boltsNm	-	-	-	-
Injector pipe unions.....Nm	-	18	-	-
Capacities				
Engine oil & filter.....litres	5.2	5.0	7.4	7.7
Gearbox.....litres	2.0	2.0	1.8	1.8
Automatic transmissionlitres	-	-	-	-
Final drivelitres	1.9	1.9	1.7 ²	1.7 ²
Cooling system.....litres	50	5.5	9.0	9.0
Fuel tank.....litres	50	50 Option: 64	70. Option: 64	70. Option: 64

Notes

200 2.0 1989 to 1995

¹New or replacement pump: 1.05 ± 0.03

300 2.5 1989 to 1991

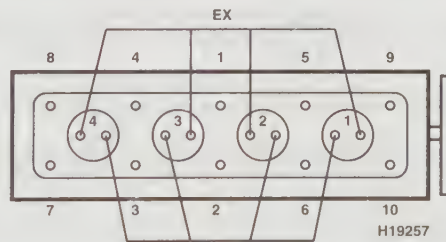
¹Twin wheel: 2.30 to 2.80

²Twin wheel: 2.4

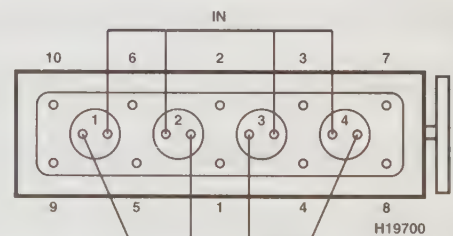
300 2.5 Turbo 1989 to 1991

¹Twin wheel: 2.30 to 2.80

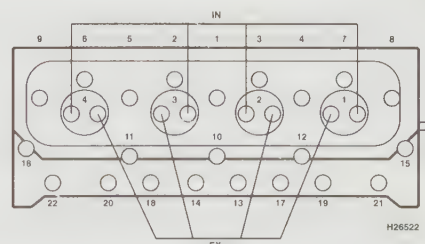
²Twin wheel: 2.4



1905 cm³



1994 cm³



2498 cm³

- Not applicable, or information not available



LEYLAND DAF (LDV)

	300 2.5 1988 to 1991	400 / Convoy 2.5D 1989 to 1997	400 / Convoy 2.5TD 1989 to 1997	Convoy 2.5D 1997 to 2000
Engine				
Engine type/code.....	15J	EN55 OHV 53kW	EN55 OHV Turbo 71kW	4HB OHV 56kW
Capacity (cm ³) / cylinders.....	2495 / 4	2498 / 4	2498 / 4	2496 / 4
Compression ratio / pressure.....bar	21.0 /	23.0 / 25.0 to 30.0	23.0 / 25.0 to 30.0	20.8 / 33.8
Torque output.....Nm	0	0	0	168
Oil pressure.....idle [running] bar	2.4 to 4.0	[3.7 @ 4500]	[3.7 @ 4500]	1.0
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0.25 H	0.15	0.15	0.20
- exhaust (mm).....	0.25 H	0.25	0.25	0.38
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-2-4-3
No. 1 cylinder position.....	TCE	-	-	-
Cooling system				
Thermostat opening temperature.....°C	82	-	-	88
Radiator cap pressure.....bar	1.0	-	-	1.0
Fuel system				
Idle speed.....rpm	670 ± 20	775 ± 25	775 ± 25	825 ± 25
Maximum (no load) speed.....rpm	-	4500 ± 50	4700	4500
Smoke test/opacity.....M-1 %	3.0	2.5	3.0	2.5
Static timing method.....	-	Plunger travel	Plunger travel	Refer to wsm
Timing dimension.....mm	-	Dimension on pump	Dimension on pump	-
Crankshaft position.....mm [°]	-	-	-	-
Turbo type / ref / pressure.....bar	-	-	0.8 bar @ 2000rpm	-
Injection pump make.....	CAV	Roto Diesel	Roto Diesel	Bosch
Injection pump part no.....	-	DPC 059	DPC 053	VE
Injector Make / type.....	-	-	-	-
Injector part no.....	-	LCR 6770701C	-	-
Injection type.....	DPA	Indirect	Indirect	VE
Injection opening pressure, New [used]...bar	135 to 140	110 to 120	125 to 135	-
Glow plugs				
Maker.....	-	Champion	Champion	-
Type.....	-	CH68	CH68	-
Nominal rating.....V/A	-	-	-	-
Brakes				
minimum friction material thickness				
Front.....mm	3.0	1.0	1.0	1.0
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size	-	-	-	-
- Estate / Van.....Size	-	-	-	205x14; 185x14
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Van.....bar	-	-	-	Owners handbook
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.0 to 1.6	-	-	0.0 to 1.6
Camber.....	2°	-	-	1°30'
Castor.....	1°	-	-	2°
King pin inclination.....	9°30'	-	-	9°30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-	-	-
Camber.....	-	-	-	-



LEYLAND DAF (LDV)

	300 2.5 1988 to 1991	400 / Convoy 2.5D 1989 to 1997	400 / Convoy 2.5TD 1989 to 1997	Convoy 2.5D 1997 to 2000
Torque wrench settings				
Cylinder head - stage 1Nm	40 to 50	30, 70	30, 70	70
- stage 2Nm	115 to 130	- 90°	- 90°	70
- stage 3Nm	-	70	70	+ 90°
- stage 4Nm	-	warm-up, wait 3 hrs,	warm-up, wait 3 hrs,	-
- stage 5Nm	-	- 90°	- 90°	-
- stage 6Nm	-	70 + 120°	70 + 120°	-
Big-end bearingsNm	37 to 41	60	60	69
Main bearingsNm	130 to 136	120	120	170
Crankshaft pulley boltNm	-	55 + 60°	55 + 60°	163
Camshaft pulley boltNm	-	-	-	160
Flywheel [driveplate] boltNm	139 to 153	15 + 60°	15 + 60°	21 + 30°
Front hubsNm	-	-	-	WSM
Rear hubsNm	136 to 163	-	-	-
Wheel nuts / boltsNm	176 to 227 ¹	Refer to vehicle	Refer to vehicle	180°
Glow plugsNm	-	-	-	-
Clutch pressure plate boltsNm	30 to 38	20	20	30
Injection pump sprocketNm	-	-	-	25
InjectorsNm	-	90	90	40
Injection pump mounting boltsNm	-	-	-	24
Injector pipe unionsNm	-	-	-	17
Capacities				
Engine oil & filterlitres	6.4	7.4	7.7	7.0
Gearboxlitres	2.0	2.0	2.0	1.3
Automatic transmissionlitres	-	-	-	-
Final drivelitres	1.7 Twin wheel: 2.4	1.9	1.9	2.4
Cooling systemlitres	8.5	-	-	11.0
Fuel tanklitres	-	-	-	70

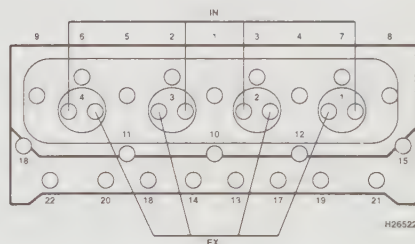
Notes

300 2.5 1988 to 1991

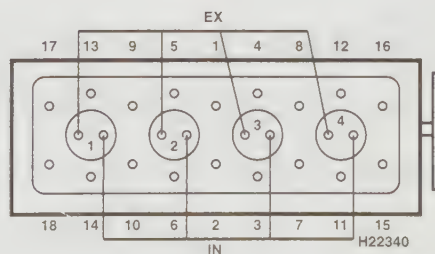
¹Twin wheel: 230 to 280

Convoy 2.5D 1997 to 2000

¹Twin wheel: 200



2498 cm³



2496 cm³

- Not applicable, or information not available



LEYLAND DAF (LDV)

Convoy 2.5TD
1997 to 2000

Engine

Engine type/code.....	4EB OHV Turbo 74kW
Capacity (cm ³) / cylinders.....	2496 / 4
Compression ration / pressurebar	18.0 / 33.8
Torque outputNm	220
Oil pressureidle [running] bar	1.0
Oil temperature°C	80
Valve clearances - inlet (mm).....	0.20
- exhaust (mm).....	0.38
Injection order.....	1-2-4-3
No. 1 cylinder position.....	-

Cooling system

Thermostat opening temperature°C	88
Radiator cap pressurebar	1.0

Fuel system

Idle speedrpm	850 ± 25
Maximum (no load) speedrpm	4400
Smoke test/opacityM ⁻¹ %	3.0
Static timing method.....	Refer to wsm
Timing dimension.....mm	-
Crankshaft positionmm [°]	-
Turbo type / ref / pressurebar	-
Injection pump make.....	Lucas
Injection pump part no.....	EPIC
Injector Make / type.....	-
Injector part no.....	-
Injection type.....	EDC
Injection opening pressure, New [used]...bar	-

Glow plugs

Maker.....	-
Type.....	-
Nominal ratingV/A	-

Brakes

minimum friction material thickness	
Front.....mm	1.0
Rear.....mm	1.5

Tyres - Saloon / Hatch.....Size

- Estate / Van.....Size	205x14: 185x14
Pressure - front / rear - Saloon / Hatch...bar	-
- Estate / Vanbar	Owners handbook

Front suspension / wheel alignment

Toe-in (+) / Toe-out (-).....mm [°]	0.0 to 1.6
Camber.....	1°30'
Castor.....	2°
King pin inclination.....	9°30'

Rear suspension / wheel alignment

Toe-in (+) / Toe-out (-).....mm [°]	-
Camber.....	-



LEYLAND DAF (LDV)

Convoy 2.5TD
1997 to 2000

Torque wrench settings

Cylinder head - stage 1	Nm	70			
- stage 2	Nm	70			
- stage 3	Nm	+ 90°			
- stage 4	Nm	-			
- stage 5	Nm	-			
- stage 6	Nm	-			
Big-end bearings	Nm	69 N			
Main bearings	Nm	170			
Crankshaft pulley bolt	Nm	163			
Camshaft pulley bolt	Nm	160			
Flywheel [driveplate] bolt	Nm	21 + 30°			
Front hubs	Nm	WSM			
Rear hubs	Nm	-			
Wheel nuts / bolts	Nm	200 ¹			
Glow plugs	Nm	-			
Clutch pressure plate bolts	Nm	30			
Injection pump sprocket	Nm	25			
Injectors	Nm	40			
Injection pump mounting bolts	Nm	24			
Injector pipe unions	Nm	17			

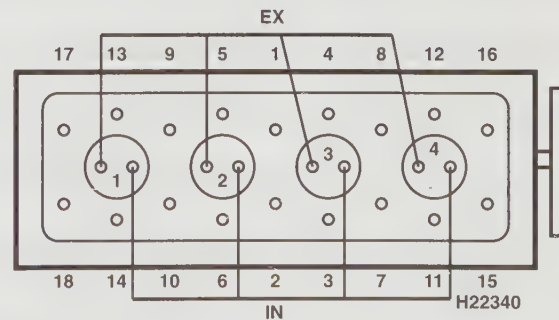
Capacities

Engine oil & filter	litres	7.0			
Gearbox	litres	1.3			
Automatic transmission	litres	-			
Final drive	litres	2.4			
Cooling system	litres	11.0			
Fuel tank	litres	70			

Notes

Convoy 2.5TD 1997 to 2000

¹Twin wheel: 250



2496 cm³

- Not applicable, or information not available



MAZDA

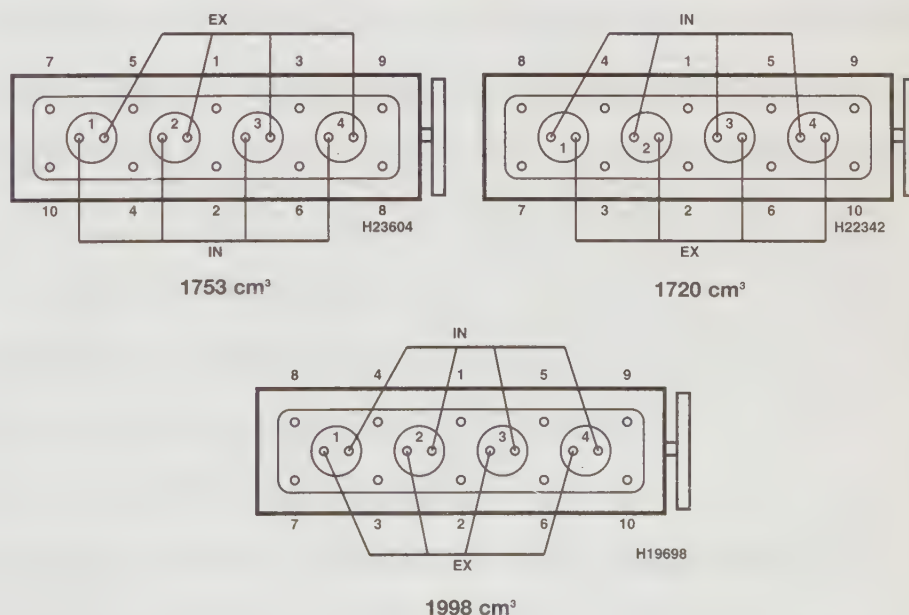
	121 1.8D 1996 to 1997	323, 1.7 1989 to 1994	626 2.0 1990 to 1992	626 2.0D 1994 to 1995
Engine				
Engine type/code.....	RTJ SOHC 44kW	PN SOHC 41kW	RF SOHC 44kW	RF SOHC 55kW
Capacity (cm ³) / cylinders.....	1753 / 4	1720 / 4	1998 / 4	1998 / 4
Compression ratio / pressurebar	21.5 / 28.0	22.2 / ≥26.5	22.7 / ≥26.5	21.1 / 29.0
Torque outputNm	105	0	0	173
Oil pressureidle [running] bar	[1.5 @ 2000]	[≥3.0]	[≥3.0]	1.5 [3.5 @ 3000]
Oil temperature°C	80	80	-	80
Valve clearances - inlet (mm).....	0.30 to 0.40	0.15	0.25	0.25
- exhaust (mm).....	0.45 to 0.55	0.25	0.35	0.35
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	-
Cooling system				
Thermostat opening temperature°C	85	84 to 88	88 ± 1.5	83
Radiator cap pressurebar	1.2	0.76 to 1.04	0.9 ± 0.1	0.95 to 1.25
Fuel system				
Idle speedrpm	850 ± 50	800 +30 -0	700 +30 -0	725 ± 25
Maximum (no load) speedrpm	5350	5700	5400	5100
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Refer to wsm	Plunger travel	Plunger travel	Rotor lift
Timing dimension.....mm	-	0.53	1.0	1.0
Crankshaft positionmm [°]	-	[2] ATDC	[0] TDC	TDC
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make.....	Bosch	Diesel Kiki	Diesel Kiki	Bosch
Injection pump part no.....	-	PN46 13 800: 104740-0420	RF11 13 800B: 104748-0172	ZEXEL
Injector Make / type.....	Pintle	Bosch	Throttle type	-
Injector part no.....	-	-	1	-
Injection type.....	Indirect	Bosch VE type	Bosch VE type	Indirect VE
Injection opening pressure, New [used]...bar	134	108	132.5	132
Glow plugs				
Maker.....	Beru	Champion	Bosch	Bosch
Type.....	666 MJ	CH97	0250 202 056	0250 202 056
Nominal rating.....V/A	-	10.5 / 16.5	10.5 / 16.5	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	1.5	2.0	2.0	2.0
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size	165/70x13	155x13: 175/70x13	185/70x14	195/65x14
- Estate / Van.....Size	-	155x13: 175/70x13	185/70x14	-
Pressure - front / rear - Saloon / Hatch...bar	2.4 / 1.8	1.8 / 1.8	2.2 / 1.8	2.2 / 1.8
- Estate / Van.....bar	-	1.8 / 1.8	2.2 / 1.8	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.0 ± 1.0	2.0 ± 3.0	3.0 ± 3.0	3.0 ± 3.0
Camber.....	-2°4'	49' ± 30'	17' ± 45'	-0°36' ± 45'
Castor.....	0°5'	2°9' ± 45' Est: 1°35' ± 45'	1°13' ± 45'	2°37' ± 45'
King pin inclination.....	-	12°22'	12°47'	15°04'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.3	2.0 ± 3.0	0 ± 3.0	3.0 ± 3.0
Camber.....	-0°30'	-5' ± 45'	-30' ± 45'	-0°7' ± 45'



MAZDA

	121 1.8D 1996 to 1997	323, 1.7 1989 to 1994	626 2.0 1990 to 1992	626 2.0D 1994 to 1995
Torque wrench settings				
Cylinder head - stage 1Nm	10 N	29	30	30
- stage 2Nm	100, wait 3 mins	+ 90°	+ 90°	+ 90°
- stage 3Nm	slacken	+ 90°	+ 90°	+ 90°
- stage 4Nm	70	-	-	-
- stage 5Nm	+ 120°	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	60 + 20° N	15 + 90° N	69 to 73 N	68 N
Main bearings.....Nm	75	62 to 72 in stages	83 to 88	88
Crankshaft pulley boltNm	150, slacken, 120 + 60°	10 to 15	157 to 167	176
Camshaft pulley boltNm	-	39 to 54	56 to 65	65
Flywheel [driveplate] bolt.....Nm	18 + 45° + 45°	67 to 76	176 to 186	186
Front hubsNm	270	WSM	235 to 319	310
Rear hubsNm	270	-	98 to 117	170
Wheel nuts / boltsNm	85	118	118	118
Glow plugsNm	28	15 to 23	15 to 20	20
Clutch pressure plate boltsNm	30	18 to 26	22 to 32	26
Injection pump sprocket.....Nm	23	59 to 69	69 to 79	68
Injectors.....Nm	70	59 to 69	59 to 69	68
Injection pump mounting boltsNm	20	19 to 25	-	25
Injector pipe unions.....Nm	25	26 to 33	31 to 46	33
Capacities				
Engine oil & filter.....litres	4.5	3.9	5.5	5.5
Gearbox.....litres	2.8	2.7	3.4	2.7
Automatic transmissionlitres	-	-	-	-
Final drivelitres	WT	WT	WT	WT
Cooling system.....litres	9.3	6.0	9.5	9.5
Fuel tank.....litres	42	50	60	60

Notes



- Not applicable, or information not available



MAZDA

	B2200 Pick-up 1986 to 1997	E2200 1990 to 2000		
Engine				
Engine type/code	R2 SOHC 47kW	R2 SOHC 52kW		
Capacity (cm ³) / cylinders	2184 / 4	2184 / 4		
Compression ratio / pressure	22.9 / ≥27.0	22.9 /		
Torque output	136	136		
Oil pressureidle [running] bar	[4.0 to 4.8]	[4.0 @ 3000]		
Oil temperature°C	—	80		
Valve clearances - inlet (mm)	0.25	0.25		
- exhaust (mm)	0.35	0.35		
Injection order	1-3-4-2	1-3-4-2		
No. 1 cylinder position	F	TBE		
Cooling system				
Thermostat opening temperature°C	86.5 to 89.5	87		
Radiator cap pressure	0.8 to 1.0	0.75 to 1.05		
Fuel system				
Idle speedrpm	700 to 750	700 to 750		
Maximum (no load) speedrpm	5100	5100		
Smoke test/opacityM ⁻¹ %	2.5	2.5		
Static timing method	Plunger travel	Plunger travel		
Timing dimension	1.0 ± 0.02	1.0		
Crankshaft positionmm [°]	[2]	[2]		
Turbo type / ref / pressure	—	—		
Injection pump make	Diesel Kiki	Diesel Kiki		
Injection pump part no	R230-13-800A: 104748-0151	VE		
Injector Make / type	Throttle type	Throttle type		
Injector part no	—	104748 - 0151		
Injection type	Bosch VE type	Indirect VE		
Injection opening pressure, New [used]...bar	132	132		
Glow plugs				
Maker	Champion	Bosch		
Type	CH97	0250 202 007		
Nominal rating	10.5 / 16.5	10.5 / 16.5		
Brakes				
minimum friction material thickness				
Front	3.0	1.0		
Rear	1.0	1.0		
Tyres - Saloon / Hatch				
- Estate / Van	185x14	185x14		
Pressure - front / rear - Saloon / Hatch...bar	—	—		
- Estate / Van	1.8 / 2.4	3.0 / 4.5		
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-)	0 to 6.0	0.0 to 3.0		
Camber	25' to 1°15'	0°30' ± 30'		
Castor	5' to 1°35'	3°58' -1° -40'		
King pin inclination	8°15'	—		
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-)	—	—		
Camber	—	—		



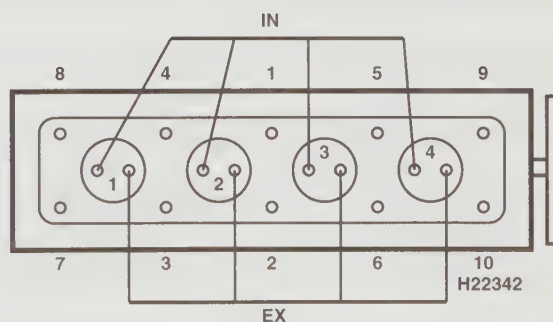
MAZDA

B2200 Pick-up
1986 to 1997
E2200
1990 to 2000
Torque wrench settings

Cylinder head - stage 1	Nm	29	29
- stage 2	Nm	+ 90°	+ 90°
- stage 3	Nm	+ 90°	+ 90°
- stage 4	Nm	-	-
- stage 5	Nm	-	-
- stage 6	Nm	-	-
Big-end bearings	Nm	65 to 69	67 N
Main bearings	Nm	83 to 88	86
Crankshaft pulley bolt	Nm	157 to 167	33
Camshaft pulley bolt	Nm	55 to 65	66
Flywheel [driveplate] bolt	Nm	176 to 186	176
Front hubs	Nm	WSM	-
Rear hubs	Nm	-	-
Wheel nuts / bolts	Nm	118 to 147	100
Glow plugs	Nm	15 to 20	20
Clutch pressure plate bolts	Nm	18 to 26	25
Injection pump sprocket	Nm	59 to 69	75
Injectors	Nm	59 to 69	65
Injection pump mounting bolts	Nm	-	46
Injector pipe unions	Nm	31 to 44	23

Capacities

Engine oil & filter	litres	5.4	5.8
Gearbox	litres	2.0	2.5
Automatic transmission	litres	-	-
Final drive	litres	1.3	1.3
Cooling system	litres	7.5	9.0
Fuel tank	litres	66	62

Notes


- Not applicable, or information not available



MERCEDES-BENZ

	190D & CAT ¹ (201.122) 1984 to 1993	190D 2.5 & CAT ¹ (201.126) 1985 to 1993	190D 2.5 Turbo (201.128) 1987 to 1993	C220D (202.121/182) 1993 to 1999
Engine				
Engine type/code.....	601.911 SOHC 55kW	602.911 SOHC 69kW	602.961 SOHC Turbo 93kW	604.910 DOHC 16V 70kW
Capacity (cm ³) / cylinders.....	1997 / 4	2497 / 5	2497 / 5	2155 / 4
Compression ratio / pressure.....bar	22.0 / ≥18.0	22.0 / ≥18.0	22.0 / ≥18.0	22.0 / 26.0
Torque outputNm	0	0	0	150
Oil pressureidle [running] bar	0.3 [3.0]	0.3 [3.0]	0.3 [3.0]	≥3.0 @ 3000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order.....	1-3-4-2	1-2-4-5-3	1-2-4-5-3	1-3-4-2
No. 1 cylinder position.....	TCE	TCE	TCE	-
Cooling system				
Thermostat opening temperature°C	85 ± 2	85 ± 2	85 ± 2	87
Radiator cap pressure.....bar	1.2 or 1.4	1.2 or 1.4	1.2 or 1.4	1.3 to 1.5
Fuel system				
Idle speedrpm	750 ± 50 Electronic: 720 ± 20	700 ± 50 Electronic: 680 ± 20	680 ± 20	690 to 790
Maximum (no load) speedrpm	5150 ± 150	5150 ± 150	5150 ± 150	5200 to 5600
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	1.99
Static timing method.....	Refer to wsm	Refer to wsm	Refer to wsm	Refer to wsm
Timing dimension.....mm	-	-	-	-
Crankshaft positionmm [°]	[15 ± 1] ATDC	[15 ± 1] ATDC	[24 ± 1] ATDC	[14.0 to 14.5] ATDC
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	Bosch	Bosch	Bosch	Lucas
Injection pump part no.....	6010700501, 0401, 3001, 3101	6020700101, 05/21/32/33/3401	602 070 14 01	R86 40A 030A
Injector Make / type.....	Bosch	Bosch	Bosch	CAV
Injector part no.....	DNOSD261	DNOSD265	DNOSD265	LDC 001 R03
Injection type.....	PES4M 55C320RS152-1, 152-3, 169	PES5M 55C320RS 153, 170	PES5M 55C320RS 158-1	Indirect
Injection opening pressure, New [used]...bar	≥115 [100]	≥135 [120]	≥135 [120]	115 to 125 [100]
Glow plugs				
Maker.....	Bosch	Bosch	Bosch	Bosch
Type.....	0250 201 117 or 0250 201 026 ²	0250 201 117 or 0250 201 026 ²	0250 201 026	0250 201 035
Nominal rating.....V/A	11 / 12	11 / 12	-	11 / 15
Brakes				
minimum friction material thickness				
Front.....mm	3.5	3.5	3.5	-
Rear.....mm	2.0	2.0	2.0	-
Tyres - Saloon / Hatch.....Size	185/65x15	185/65x15	185/65x15	195/65x15: 205/60x15
- Estate / Van.....Size	-	-	-	-
Pressure - front / rear - Saloon / Hatch...bar	1.8 / 2.0	1.8 / 2.0	2.0 / 2.2 ¹	2.1 / 2.3
- Estate / Vanbar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[20' ± 10']	[20' ± 10']	[20' ± 10']	[0°25' ± 10']
Camber.....	0 11.88 ▶: -25' +10 -20'	0 11.88 ▶: -25' +10 -20'	0 11.88 ▶: -25' +10 -20'	-0°35' ± 20'
Castor.....	10°10' 11.88 ▶: 10°25' ± 30'	10°10' 11.88 ▶: 10°25' ± 30'	10°10' 11.88 ▶: 10°25' ± 30'	4°40' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[25' +10' -5']	[25' +10' -5']	[25' +10' -5']	[0°33' ± 7']
Camber.....	-1°30' ± 30'	-1°30' ± 30'	-1°30' ± 30'	-



MERCEDES-BENZ

	190D & CAT ¹ (201.122) 1984 to 1993	190D 2.5 & CAT ¹ (201.126) 1985 to 1993	190D 2.5 Turbo (201.128) 1987 to 1993	C220D (202.121/182) 1993 to 1999
Torque wrench settings				
Cylinder head - stage 1Nm	15	15	15	15 ¹
- stage 2Nm	35	35	35	35
- stage 3Nm	wait 10 mins	wait 10 mins	wait 10 min	+ 90°
- stage 4Nm	+ 90°	+ 90°	+ 90°	Wait 10 mins
- stage 5Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 6Nm	Bolts a: 25	Bolts a: 25	Bolts a: 25	-
Big-end bearingsNm	30 + 90 to 100° N	30 + 90 to 100° N	30 + 90 to 100° N	40 + 90° N
Main bearingsNm	M12: 90°	M12: 90°	M12: 90°	55 + 90° to 100°
Crankshaft pulley boltNm	320	320	320	200 + 90°
Camshaft pulley boltNm	M10: 65 ⁴	M10: 65 ⁴	M10: 65°	18
Flywheel [driveplate] boltNm	35 + 90 to 100°	35 + 90 to 100°	35 + 90 to 100°	40 + 90°
Front hubsNm	WSM	WSM	WSM	-
Rear hubsNm	-	-	-	200 to 240
Wheel nuts / boltsNm	110	110	110	110
Glow plugsNm	20 to 22	20 to 22	20 to 22	20
Clutch pressure plate boltsNm	25	25	25	25
Injection pump sprocketNm	40 to 50	40 to 50	40 to 50	-
InjectorsNm	Vert ¹ : 70 to 80°	Vert ¹ : 70 to 80°	40 to 50	40
Injection pump mounting boltsNm	20 to 25	20 to 25	20 to 25	-
Injector pipe unionsNm	10 to 20	10 to 20	10 to 20	20
Capacities				
Engine oil & filterlitres	6.0	6.5	7.0	7.0
Gearboxlitres	1.3 [1.5]	1.5	1.5	1.5
Automatic transmissionlitres	5.5	5.5	6.0	6.2
Final drivelitres	0.7 ASD: 1.1	0.7 ASD: 1.1	1.1	0.7
Cooling systemlitres	8.0	9.0	9.0	8.3
Fuel tanklitres	55	55	55	62

Notes

190D & CAT¹ (201.122) 1984 to 1993

¹Catalyst standard from 6.90

²0250 201 026 is for diagonal injection: 14 to 16 @ 8.0

³M11 bolts: 55 + 90 to 100°

⁴M11 bolts: 25 + 90°

⁵Diagonal injection: 40 to 50

190D 2.5 & CAT¹ (201.126) 1985 to 1993

¹Catalyst standard from 6.90

²0250 201 026 is for diagonal injection: 14 to 16 @ 8.0

³M11 bolts: 55 + 90 to 100°

⁴M11 bolts: 25 + 90°

⁵Diagonal injection: 40 to 50

190D 2.5 Turbo (201.128) 1987 to 1993

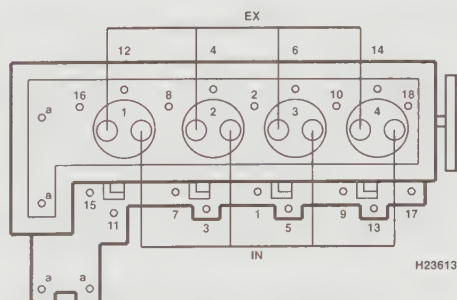
¹7.88 ▶: 2.1 / 2.3

³M11 bolts: 55 + 90 to 100°

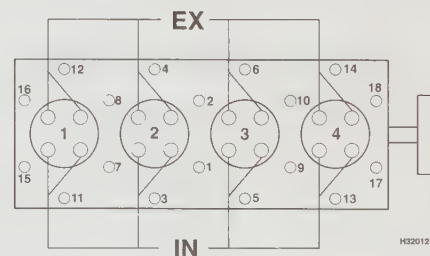
⁴M11 bolts: 25 + 90°

C220D (202.121/182) 1993 to 1999

¹Bolt length below head: ≤104 mm



1997 cm³ / 2497 cm³

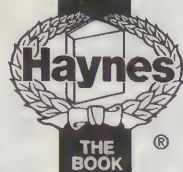


2155 cm³



MERCEDES-BENZ

	C250 D (202) 1993 to 1996	C250 TD (202.128 / 188) 1996 to 2000	250D, 250TD ¹ (124.125 / 185) 1985 to 1993	E250D (210.010) 1993 to 1998
Engine				
Engine type/code.....	605.910 83kW	605.960 DOHC 20V 110kW	602.912 SOHC 69kW	605.912 DOHC 20V 83kW
Capacity (cm ³) / cylinders.....	2497 / 5	2497 / 5	2497 / 5	2497 / 5
Compression ratio / pressure.....bar	22.0 /	22.0 /	22.0 / ≥18.0	22.0 / 26.0
Torque output.....Nm	280	280	0	170
Oil pressure.....idle [running] bar	≥3.0 @ 3000]	[3.0 @ 3000]	0.3 [3.0]	[3.0 @ 3000]
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order.....	1-2-4-5-3	1-2-4-5-3	1-2-4-5-3	1-2-4-5-3
No. 1 cylinder position.....	-	-	TCE	TCE
Cooling system				
Thermostat opening temperature.....°C	87	87	85 ± 2	85
Radiator cap pressure.....bar	1.3 to 1.5	1.3 to 1.5	1.2 or 1.4	1.3 to 1.5
Fuel system				
Idle speed.....rpm	610 to 710	610 to 710	700 ± 50 Electronic: 680 ± 20	610 to 710
Maximum (no load) speed.....rpm	5200 to 5600	5200 to 5600	5150 ± 150	5200 to 5600
Smoke test/opacity.....M ⁻¹ %	1.9	1.9	1.9	1.9
Static timing method.....	Refer to wsm	Refer to wsm	Refer to wsm	Refer to wsm
Timing dimension.....mm	-	-	-	-
Crankshaft position.....mm [°]	[14 to 14.5] ATDC	[14.0 to 14.5 ATDC]	[15 ± 1] ATDC	[14.0 to 14.5 ATDC]
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	0400 195 001	0400 195 001	6020700101, 05/21/32/33/3401	PES 5 M 55C 320 RS 202
Injector Make / type.....	Bosch	Bosch	Bosch	Bosch
Injector part no.....	0430 211 997	-	DNOSD265	0432 217 253
Injection type.....	Indirect	Indirect	PESM 55C320RS 153, 170	Indirect
Injection opening pressure, New [used]...bar	115 to 125 [100]	115 to 125 [110]	≥135 [120]	115 to 125 [100]
Glow plugs				
Maker.....	Bosch	Bosch	Bosch	Bosch
Type.....	0250 201 035	0250 201 038	0250 201 117 or 0250 201 026 ²	0250 201 035
Nominal rating.....V/A	11 / 15	-	-	11 / 15
Brakes				
minimum friction material thickness				
Front.....mm	-	-	3.5	3.5
Rear.....mm	-	-	2.0	2.5
Tyres - Saloon / Hatch.....Size	195/65x15: 205/60x15	195/65x15: 205/60x15	195/65x15	205/60x15: 205/65x15
- Estate / Van.....Size	-	-	195/65x15	205/65x15: 215/55x16
Pressure - front / rear - Saloon / Hatch...bar	Refer to vehicle	Refer to vehicle	2.0 / 2.2 ²	Refer to vehicle
- Estate / Van.....bar	-	-	2.0 / 2.2	Refer to vehicle
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°25' ± 10']	[0°25' ± 10']	[20' ± 10']	WSM
Camber.....	-0°35' ± 20'	-0°35' ± 20'	-5' 11.88 ▶: -25' +10' -20'	-0°37' ± 20'
Castor.....	4°40' ± 30'	4°40' ± 30'	10°10' 11.88 ▶: 10°25' ± 30'	5°22' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°33' ± 7']	[0°33' ± 7']	[20' to 35']	[0°37' ± 7']
Camber.....	-	-	-1°30' ± 30'	-



MERCEDES-BENZ

	C250 D (202) 1993 to 1996	C250 TD (202.128 / 188) 1996 to 2000	250D, 250TD ¹ (124.125 / 185) 1985 to 1993	E250D (210.010) 1993 to 1998
Torque wrench settings				
Cylinder head - stage 1.....Nm	15 ¹	15 ¹	15	15 N
- stage 2.....Nm	35	35	35	35
- stage 3.....Nm	+ 90°	+ 90°	wait 10 min	+ 90°
- stage 4.....Nm	wait 10 mins	wait 10 mins	+ 90°	wait 10 mins, + 90°
- stage 5.....Nm	+ 90°	+ 90°	+ 90°	-
- stage 6.....Nm	-	-	Bolts a: 25	-
Big-end bearings.....Nm	30 + 90° to 100° N	30 + 90° to 100° N	30 + 90 to 100° N	40 + 90° N
Main bearings.....Nm	55 + 90° to 100°	55 + 90° to 100°	M12: 90°	55 + 90° ¹
Crankshaft pulley bolt.....Nm	-	200 + 90°	320	200 + 90°
Camshaft pulley bolt.....Nm	-	18	M10: 65°	18
Flywheel (driveplate) bolt.....Nm	40 + 90°	40 + 90°	35 + 90 to 100°	40 + 90°
Front hubs.....Nm	-	-	WSM	WSM
Rear hubs.....Nm	200 to 240	200 to 240	-	220
Wheel nuts / bolts.....Nm	110	110	110	110
Glow plugs.....Nm	-	20	20 to 22	20
Clutch pressure plate bolts.....Nm	25	25	25	25
Injection pump sprocket.....Nm	-	-	40 to 50	-
Injectors.....Nm	40	-	Vert ¹ : 70 to 80°	40
Injection pump mounting bolts.....Nm	-	-	20 to 25	20
Injector pipe unions.....Nm	20	20	10 to 20	20
Capacities				
Engine oil & filter.....litres	7.5	7.5	7.0	7.5
Gearbox.....litres	1.5	1.5	1.5	1.5
Automatic transmission.....litres	6.2	6.2	5.5	6.2
Final drive.....litres	1.1	1.1	0.7	1.1
Cooling system.....litres	9.6	9.6	9.0 A/C: 9.5	9.0
Fuel tank.....litres	62	62	70 TD: 72	72

Notes

C250 D (202) 1993 to 1996

¹Bolt length below head: ≤ 104 mm

C250 TD (202.128 / 188) 1996 to 2000

¹Bolt length below head: ≤ 104 mm

250D, 250TD¹ (124.125 / 185) 1985 to 1993

¹Catalyst standard from 6.90

²0250201026 is for diagonal injection: 14 to 16 @ 8.0

³11.85 ▶: 2.0 / 2.0

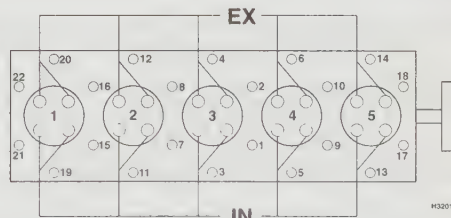
⁴M11 bolts: 55 + 90 to 100°

⁵M11 bolts: 25 + 90°

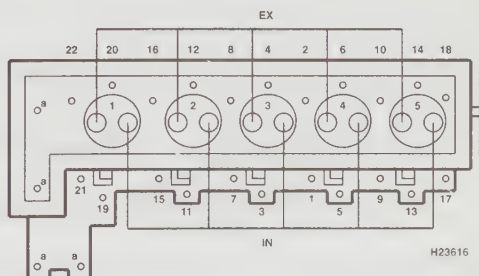
⁶Diagonal injection: 40 to 50

E250D (210.010) 1993 to 1998

¹Max bolt length: ≤ 63.8 mm



2497 cm³



2497 cm³ (250D, 250TD¹ (124.125 / 185) 1985 to 1993)

- Not applicable, or information not available



MERCEDES-BENZ

	300D, TD ¹ (124.130/190) 1985 to 1993	300D, TD Turbo (124.133/193) 1985 to 1993	300D 4MATIC ¹ (124.330) 1987 to 1993	300D, TD Turbo ¹ (124.333/39) 1987 to 1993
Engine				
Engine type/code.....	603.912 SOHC 83kW	603.960 SOHC Turbo 108kW	603.913 SOHC 83kW	603.963 SOHC Turbo 108kW
Capacity (cm ³) / cylinders.....	2996 / 6	2996 / 6	2996 / 6	2996 / 6
Compression ratio / pressure.....bar	22.0 / ≥18.0	22.0 / ≥18.0	22.0 / ≥18.0	22.0 / ≥18.0
Torque outputNm	0	0	0	0
Oil pressureidle [running] bar	0.3 [3.0]	0.3 [3.0]	0.3 [3.0]	0.3 [3.0]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order.....	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
No. 1 cylinder position.....	TCE	TCE	TCE	TCE
Cooling system				
Thermostat opening temperature°C	85 ± 2	80 ± 2	85 ± 2	80 ± 2
Radiator cap pressurebar	1.2 or 1.4	1.2 or 1.4	1.2 or 1.4	1.2 or 1.4
Fuel system				
Idle speedrpm	630 ± 20 [680 ± 20]	630 ± 20	630 ± 20 [680 ± 20]	630 ± 20
Maximum (no load) speedrpm	5150 ± 150	5150 ± 150	5150 ± 150	5150 ± 150
Smoke test/opacityM ⁻¹ %	2.1	2.5	2.1	2.5
Static timing method.....	Refer to wsm	Refer to wsm	Refer to wsm	Refer to wsm
Timing dimension.....mm	-	-	-	-
Crankshaft positionmm [°]	[15 ± 1] ATDC	[15 ± 1] ATDC	[15 ± 1] ATDC	[15 ± 1] ATDC
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make.....	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	6030700101, 1901, 2501, 2601	603 070 12 01	6030700101, 1901, 2501, 2601	603 070 12 01
Injector Make / type.....	Bosch	Bosch	Bosch	Bosch
Injector part no.....	DNOSD265	DNOSD265	DNOSD265	DNOSD265
Injection type.....	PES6M 55C320RS 156, 171	PES6M 55C320RS 157-1	PES6M 55C320RS 156, 171	PES6M 55C320RS 157-1
Injection opening pressure, New [used]...bar	≥135 [120]	≥135 [120]	≥135 [120]	≥135 [120]
Glow plugs				
Maker.....	Bosch	Bosch	Bosch	Bosch
Type.....	0250 201 117 or 0250 201 026 ²	0250 201 117 or 0250 201 026 ¹	0250 201 117 or 0250 201 026 ²	0250 201 117 or 0250 201 026 ²
Nominal rating.....V/A	11 / 12	11 / 12	11 / 12	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	3.5	3.5	3.5	3.5
Rear.....mm	2.0	2.0	2.0	2.0
Tyres - Saloon / Hatch.....Size	195/65x15	195/65x15	195/65x15	195/65x15
- Estate / Van.....Size	195/65x15	195/65x15	-	195/65x15
Pressure - front / rear - Saloon / Hatch...bar	2.0 / 2.2 ³	2.2 / 2.2	2.4 / 2.4	2.4 / 2.4
- Estate / Vanbar	2.0 / 2.2	2.0 / 2.5	-	2.2 / 2.5
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[20' ± 10']	[20' ± 10']	[20' ± 10']	[20' ± 10']
Camber.....	-5' 11.88 ▶: -25' +10' -20'	-5' 11.88 ▶: -25' +10' -20'	-15' +10' -20'	-15' +10' -20'
Castor.....	10°10' 11.88 ▶: 10°25' ± 30'	10°10' 11.88 ▶: 10°25' ± 30'	10°20' ± 30'	10°20' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[20' to 35']	[20' to 35']	[20' to 35']	[20' to 35']
Camber.....	-1°30' ± 30'	-1°30' ± 30'	-1°30' ± 30'	-1°30' ± 30'



MERCEDES-BENZ

	300D, TD ¹ (124.130/190) 1985 to 1993	300D, TD Turbo (124.133/193) 1985 to 1993	300D 4MATIC ¹ (124.330) 1987 to 1993	300D, TD Turbo ¹ (124.333/199) 1987 to 1993
Torque wrench settings				
Cylinder head - stage 1	15	15	15	15
- stage 2	35	35	35	35
- stage 3	wait 10 min	wait 10 min	wait 10 min	wait 10 min
- stage 4	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5	+ 90°	+ 90°	+ 90°	+ 90°
- stage 6	Bolts a: 25	Bolts a: 25	Bolts a: 25	Bolts a: 25
Big-end bearings	30 + 90 to 100° N	30 + 90 to 100° N	30 + 90 to 100° N	30 + 90 to 100° N
Main bearings	M12: 90°	M12: 90°	M12: 90°	M12: 90°
Crankshaft pulley bolt	320	320	320	320
Camshaft pulley bolt	M10: 65°	M10: 65°	M10: 65°	M10: 65°
Flywheel [driveplate] bolt	35 + 90 to 100°	35 + 90 to 100°	40 + 90 to 100°	35 + 90 to 100°
Front hubs	WSM	WSM	WSM	WSM
Rear hubs	-	-	-	-
Wheel nuts / bolts	110	110	110	110
Glow plugs	20 to 22	20 to 22	20 to 22	20 to 22
Clutch pressure plate bolts	25	25	25	25
Injection pump sprocket	40 to 50	40 to 50	40 to 50	40 to 50
Injectors	Vert ¹ : 70 to 80°	Vert ¹ : 70 to 80°	Vert ¹ : 70 to 80°	Vert ¹ : 70 to 80°
Injection pump mounting bolts	20 to 25	20 to 25	20 to 25	20 to 25
Injector pipe unions	10 to 20	10 to 20	10 to 20	10 to 20
Capacities				
Engine oil & filter	7.0	7.5	7.5	7.5
Gearbox	1.5	-	1.5 Transfer: 0.6	-
Automatic transmission	6.0	6.2	6.2	6.2
Final drive	1.1	1.1	1.1 Front: 1.0	1.1
Cooling system	9.0 A/C: 9.5	10.0	9.0 A/C: 9.5	10.0
Fuel tank	70 TD: 72	70 TD: 72	70	70 TD: 72

Notes

300D, TD¹ (124.130/190) 1985 to 1993

¹Catalyst standard from 6.90

²0250201026 is for diagonal injection: 14 to 16 @ 8.0

³11.85 ▶: 2.0 / 2.0

⁴M11 bolts: 55 + 90 to 100°

⁵M11 bolts: 25 + 90°

⁶Diagonal injection: 40 to 50

300D, TD Turbo (124.133/193) 1985 to 1993

¹0250201026 is for diagonal injection: 14 to 16 @ 8.0

²M11 bolts: 55 + 90 to 100°

³M11 bolts: 25 + 90°

⁴Diagonal injection: 40 to 50

300D 4MATIC¹ (124.330) 1987 to 1993

¹Catalyst standard from 6.90

²0250 201 026 is for diagonal injection: 14 to 16 @ 8.0

³M11 bolts: 55 + 90 to 100°

⁴M11 bolts: 25 + 90°

⁵Diagonal injection: 40 to 50

300D, TD Turbo¹ (124.333/39) 1987 to 1993

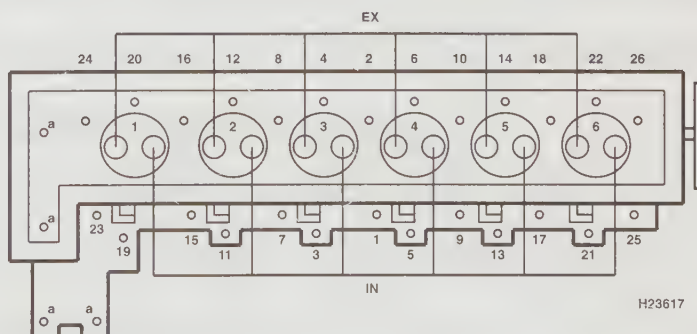
¹4MATIC

²0250 201 026 is for diagonal injection: 14 to 16 @ 8.0

³M11 bolts: 55 + 90 to 100°

⁴M11 bolts: 25 + 90°

⁵Diagonal injection: 40 to 50



2996 cm³

– Not applicable, or information not available



MERCEDES-BENZ

	E300 D 1993 to 1996	E300 TD 1995 to 2000	E300 TD (210.020) 1997 to 2000	Vito 108D 1996 to 1999
Engine				
Engine type/code	606.910 DOHC 24V 100kW	606.910 DOHC 24V 100kW	606.912 DOHC 24V 130kW	OM601.942 SOHC 58kW
Capacity (cm ³) / cylinders	2996 / 6	2996 / 6	2996 / 6	2299 / 4
Compression ratio / pressure	22.0 / 26.0	22.0 / ≥18.0	22.0 / ≥18.0	22.0 / ≥18.0
Torque output	0	210	330	152
Oil pressureIdle [running] bar	[3.0 @ 3000]	[3.0 @ 3000]	-	[3.0 @ 3000]
Oil temperature	80	80	-	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-3-4-2
No. 1 cylinder position	-	TCE	TCE	-
Cooling system				
Thermostat opening temperature	85	85	85	87
Radiator cap pressure	1.3 to 1.5	1.3 to 1.5	1.3 to 1.5	1.4
Fuel system				
Idle speed	580 to 680	580 to 680	580 to 680	720 ± 50
Maximum (no load) speed	5600	5200 to 5600	5200 to 5600	3800
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method	Refer to wsm	Refer to wsm	Refer to wsm	-
Timing dimension	-	-	-	-
Crankshaft positionmm [°]	[14.0 to 14.5 ATDC]	[14.0 to 14.5 ATDC]	[14.0 to 14.5 ATDC]	-
Turbo type / ref / pressure	-	-	-	-
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.	0400 076 954	PES 6M 55C 320 RS 203	PES 6M 55C 320 RS 203	PES 4M 55C 320 RS167
Injector Make / type	Bosch	Bosch	Bosch	Bosch
Injector part no.	0432 217 253	DN OSD 310	DN OSD 310	-
Injection type	Indirect	Indirect	Indirect	Indirect
Injection opening pressure, New [used]...bar	115 to 125 [100]	115 to 125 [100]	115 to 125 [100]	115 to 125 [110]
Glow plugs				
Maker	Bosch	Bosch	Bosch	-
Type	0250 201 035	0250 201 038	0250 201 038	-
Nominal ratingV/A	11 / 15	11.5 / 15	-	-
Brakes				
minimum friction material thickness				
Front.....mm	-	3.5	3.5	-
Rear.....mm	-	2.5	2.5	-
Tyres - Saloon / HatchSize	195/65x15	195/65x15	205/60x15: 205/65x15:215/55x16	-
- Estate / VanSize	195/65x15	195/65x15	205/65x15: 215/55x16	195/70x15
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.4	Refer to vehicle	Refer to vehicle	-
- Estate / Vanbar	2.2 / 2.5	Refer to vehicle	Refer to vehicle	Refer to vehicle
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.5 ± 1.0	WSM	WSM	-
Camber	-0°25' +10' -20'	-0°37' ± 20'	-0°37' ± 20'	-
Castor	10°27' ± 30'	5°22' ± 30'	5°22' ± 30'	-
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°25' +10' -5']	[0°33' ± 7']	[0°33' ± 7']	-
Camber	-1°30' ± 30'	-	-	-



MERCEDES-BENZ

	E300 D 1993 to 1996	E300 TD 1995 to 2000	E300 TD (210.020) 1997 to 2000	Vito 108D 1996 to 1999
Torque wrench settings				
Cylinder head - stage 1.....Nm	15 ¹	15 N ²	15 N	10
- stage 2.....Nm	35 + 90°	35	35	35
- stage 3.....Nm	wait 10 min	+ 90°	+ 90°	+ 180°
- stage 4.....Nm	+ 90°	wait 10 min	wait 10 min	M8: 25
- stage 5.....Nm	M8: 25	+ 90°	+ 90°	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	40 + 90° N	40 + 90° N	40 + 90° N	30 + 90° N
Main bearings.....Nm	55 + 90° ²	55 + 90° ¹	55 + 90° ¹	55 + 90°
Crankshaft pulley bolt.....Nm	200 + 90°	200 + 90°	200 + 90°	-
Camshaft pulley bolt.....Nm	18	18	18	-
Flywheel [driveplate] bolt.....Nm	40 + 90°	40 + 90°	40 + 90°	45 + 90°
Front hubs.....Nm	-	WSM	WSM	-
Rear hubs.....Nm	-	220	220	-
Wheel nuts / bolts.....Nm	110	110	110	170
Glow plugs.....Nm	20	20	20	-
Clutch pressure plate bolts.....Nm	25	25	25	25
Injection pump sprocket.....Nm	-	-	-	-
Injectors.....Nm	40	40	40	80
Injection pump mounting bolts.....Nm	-	-	-	-
Injector pipe unions.....Nm	20	20	20	-
Capacities				
Engine oil & filter.....litres	7.0	7.0	7.0	6.0
Gearbox.....litres	1.5	1.5	1.5	2.0
Automatic transmission.....litres	6.0	6.0	6.0	-
Final drive.....litres	1.1	1.1	1.1	WT
Cooling system.....litres	9.0	9.0	9.0	-
Fuel tank.....litres	-	72	72	80

Notes

E300 D 1993 to 1996

¹Bolt length below head: ≤104mm or 117mm

²Bolt length below head: ≤63.8mm

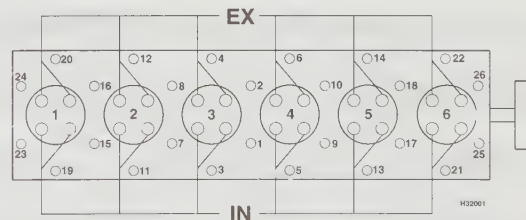
E300 TD 1995 to 2000

¹Bolt length below head: ≤63.8 mm

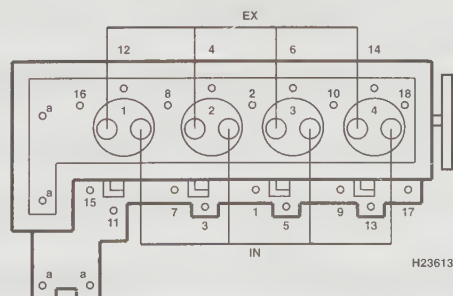
²Bolt length below head: ≤104mm or 117mm

E300 TD (210.020) 1997 to 2000

¹Max bolt length below head: ≤63.8 mm



1996 cm³ / 1996 cm³



2299 cm³

- Not applicable, or information not available



MERCEDES-BENZ

	208/308D 1989 to 1995	310/410D 1989 to 1995	408D 1989 to 1995	Sprinter 208/308 D 1997 to 2000
Engine				
Engine type/code	OM601.940 SOHC 58kW	OM602.940 SOHC 70kW	OM601.940 SOHC 58kW	OM601.943 SOHC 58kW
Capacity (cm ³) / cylinders	2299 / 4	2874 / 5	2299 / 4	2299 / 4
Compression ratio / pressure	22.0 / 18.0	22.0 / ≥18.0	22.0 / 18.0	22.0 / ≥18.0
Torque output	157	192	157	152
Oil pressureidle [running] bar	[3.0 @ 3000]	[3.0 @ 3000]	[3.0 @ 3000]	[3.0 @ 3000]
Oil temperature	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-2-4-5-3	1-3-4-2	1-3-4-2
No. 1 cylinder position	-	-	-	-
Cooling system				
Thermostat opening temperature	80	80	80	80
Radiator cap pressure	0.9 to 1.1	0.9 to 1.1	0.9 to 1.1	0.9 to 1.1
Fuel system				
Idle speed	750 ± 50	680 ± 50	720 ± 50	720 ± 50
Maximum (no load) speed	4500	4500	4500	3800
Smoke test/opacity	2.2	2.3	2.2	1.7
Static timing method	Refer to wsm	Refer to wsm	Refer to wsm	Refer to wsm
Timing dimension	-	-	-	-
Crankshaft position	[15 ± 1 ATDC]	[15 ± 1 ATDC]	[15 ± 1 ATDC]	[15 ± 1 ATDC]
Turbo type / ref / pressure	-	-	-	-
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no	0400 074 900/5	0400 075 956/47	0400 074 900/5	PES
Injector Make / type	Bosch	Bosch	Bosch	Bosch
Injector part no	0432 217 161	0432 217 161	0432 217 161	-
Injection type	Indirect	Indirect	Indirect	Indirect
Injection opening pressure, New [used]...bar	115 to 125 [100]	115 to 125 [100]	115 to 125 [100]	115 to 125 [100]
Glow plugs				
Maker	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch
Type	0250 201 026 / CH156	0250 201 026 / CH156	0250 201 026 / CH156	0250 201 026
Nominal rating	11.5 / 15	11.5 / 15	11.5 / 15	-
Brakes				
minimum friction material thickness				
Front	2.0	3.0	3.0	2.0
Rear	3.5	3.5	3.5	3.5
Tyres - Saloon / Hatch				
- Estate / Van	185x14 308D: 225/70x15	225/70x15: 185x14	185x14	195/70x15: 225/70x15
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Van	Refer to vehicle	Refer to vehicle	Refer to vehicle	Refer to vehicle
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-)	0.0	0.0	0.0	-
Camber	1°	1°	1°	-
Castor	2°30' ± 20'	2°30' ± 30'	2°30' ± 20'	-
King pin inclination	-	5°	5°	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-)	-	-	-	-
Camber	-	-	-	-



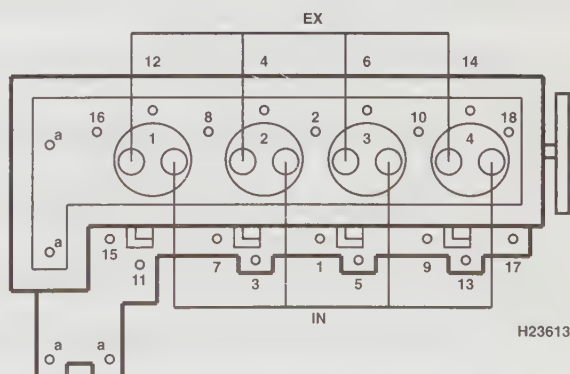
MERCEDES-BENZ

	208/308D 1989 to 1995	310/410D 1989 to 1995	408D 1989 to 1995	Sprinter 208/308 D 1997 to 2000
Torque wrench settings				
Cylinder head - stage 1.....Nm	15	15	15	15
- stage 2.....Nm	35 + 90°	35	35	35
- stage 3.....Nm	wait 10 min	+ 90°	+ 90°	+ 90°
- stage 4.....Nm	+ 90°	wait 10 min	wait 10 min	Wait 10 mins
- stage 5.....Nm	-	+ 90°	+ 90°	+ 90°
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	30 + 90°	30 + 90° N	30 + 90° N	30 + 90° N
Main bearings.....Nm	55 + 90°	55 + 90°	55 + 90°	55 + 90° N
Crankshaft pulley bolt.....Nm	320	35 + 90° ¹	200 + 90°	200 + 90° N
Camshaft pulley bolt.....Nm	-	-	-	-
Flywheel [driveplate] bolt.....Nm	35 + 90°	35 + 90°	35 + 90°	35 + 90°
Front hubs.....Nm	-	-	-	-
Rear hubs.....Nm	-	-	-	-
Wheel nuts / bolts.....Nm	170	170	170	170
Glow plugs.....Nm	-	20	-	20
Clutch pressure plate bolts.....Nm	25	25	25	25
Injection pump sprocket.....Nm	45	45	45	-
Injectors.....Nm	80	80	80	80
Injection pump mounting bolts.....Nm	25	25	25	-
Injector pipe unions.....Nm	20	20	20	-
Capacities				
Engine oil & filter.....litres	6.5	7.0	6.5	9.5
Gearbox.....litres	2.3	2.3	2.3	1.6
Automatic transmission.....litres	6.8	6.9	6.9	-
Final drive.....litres	1.4 308D: 1.6	1.6 410D: 1.8	1.8	1.5
Cooling system.....litres	7.0	7.0	7.0	7.0
Fuel tank.....litres	70	70	70	80

Notes

310/410D 1989 to 1995

¹Bolt length below head: ≤22.5mm Bolt diameter:
≥8.1 mm



2299 cm³ / 2874 cm³

- Not applicable, or information not available



MERCEDES-BENZ

	Sprinter 210/310 D 1997 to 2000	Sprinter 212/312 D 1997 to 2000		
Engine				
Engine type/code.....	OM602.980 SOHC Turbo 75kW	OM602.980 SOHC Turbo 90kW		
Capacity (cm ³) / cylinders.....	2874 / 5	2874 / 5		
Compression ratio / pressurebar	22.0 / ≥18.0	22.0 / ≥18.0		
Torque outputNm	250	280		
Oil pressureidle [running] bar	[3.0 @ 4000]	[3.0 @ 3000]		
Oil temperature°C	80	80		
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.		
- exhaust (mm)	0: Hyd.	0: Hyd.		
Injection order	1-2-4-5-3	1-2-4-5-3		
No. 1 cylinder position	-	-		
Cooling system				
Thermostat opening temperature°C	80	80		
Radiator cap pressurebar	0.9 to 1.2	0.9 to 1.1		
Fuel system				
Idle speedrpm	680 ± 50	680 ± 50		
Maximum (no load) speedrpm	-	-		
Smoke test/opacityM ⁻¹ %	2.5	1.6		
Static timing method.....	Rotor lift	Rotor lift		
Timing dimension.....mm	0.9	0.9		
Crankshaft positionmm [°]	TDC	TDC		
Turbo type / ref / pressurebar	-	-		
Injection pump make	Bosch	Bosch		
Injection pump part no.....	-	-		
Injector Make / type	Bosch	Bosch		
Injector part no.....	-	-		
Injection type.....	Indirect	Indirect		
Injection opening pressure, New [used]...bar	115 to 125 [100]	115 to 125 [100]		
Glow plugs				
Maker	Bosch/Champion	-		
Type	0250 201 026 / CH176	-		
Nominal ratingV/A	11.5 /	-		
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0		
Rear.....mm	3.5	3.5		
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/70x15: 225/70x15	195/70x15: 225/70x15		
Pressure - front / rear - Saloon / Hatch ...bar	-	-		
- Estate / Vanbar	Refer to vehicle	Refer to vehicle		
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-		
Camber	-	-		
Castor	-	-		
King pin inclination.....	-	-		
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-		
Camber	-	-		



MERCEDES-BENZ

Sprinter 210/310 D
1997 to 2000

Sprinter 212/312 D
1997 to 2000

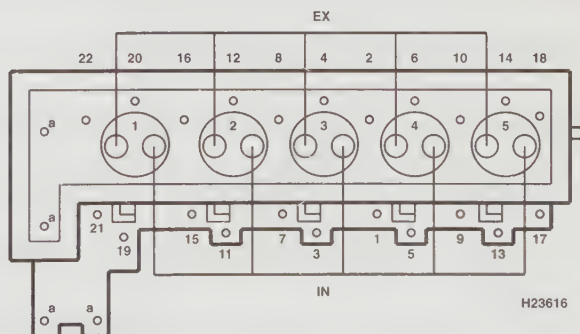
Torque wrench settings

Cylinder head - stage 1	Nm	10	10
- stage 2	Nm	35	35
- stage 3	Nm	+ 180°	+ 180°
- stage 4	Nm	Wait 10 mins	Wait 10 mins
- stage 5	Nm	+ 90°	+ 90°
- stage 6	Nm	-	-
Big-end bearings	Nm	30 + 90° N	30 + 90° N
Main bearings	Nm	55 + 90° N	55 + 90° N
Crankshaft pulley bolt	Nm	200 + 90° N	200 + 90° N
Camshaft pulley bolt	Nm	-	-
Flywheel [driveplate] bolt	Nm	35 + 90° N	35 + 90°
Front hubs	Nm	-	-
Rear hubs	Nm	-	-
Wheel nuts / bolts	Nm	170 ± 10	170 ± 10
Glow plugs	Nm	-	20
Clutch pressure plate bolts	Nm	25	25
Injection pump sprocket	Nm	-	90
Injectors	Nm	80	80
Injection pump mounting bolts	Nm	-	15
Injector pipe unions	Nm	-	-

Capacities

Engine oil & filter	litres	9.5	9.5
Gearbox	litres	1.6	1.9
Automatic transmission	litres	-	-
Final drive	litres	1.7	1.5
Cooling system	litres	7.5	7.5
Fuel tank	litres	80	80

Notes



2874 cm³

- Not applicable, or information not available



MITSUBISHI

	Galant 1800 1988 to 1993	Carisma 1.9TD 1997 to 2000	Space Wagon 2.0TD 1995 to 1996	Shogun / Pajero 2.5 Turbo 1986 to 1991
Engine				
Engine type/code	4D65-T SOHC Turbo 55kW	F8QT SOHC Turbo 66kW	4D68T SOHC Turbo 60kW	4D56T SOHC Turbo 69kW
Capacity (cm ³) / cylinders	1795 / 4	1870 / 4	1998 / 4	2477 / 4
Compression ratio / pressure	22.2 / 26.5	21.0 / 20.0	22.4 / 25.6	21.0 / 27.0
Torque output	0	176	172	240
Oil pressureIdle [running] bar	0.76	2.0 [3.5 @ 3000]	-	0.76
Oil temperature°C	80	80	-	80
Valve clearances - inlet (mm)	0.25 H	0.15 to 0.25	0.25	0.25 H
- exhaust (mm)	0.25 H	0.35 to 0.45	0.35	0.25 H
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	-	-	F
Cooling system				
Thermostat opening temperature°C	82	76	82	82
Radiator cap pressure	0.76 to 1.04	0.75 to 1.05	0.8 to 1.0	0.76 to 1.04
Fuel system				
Idle speedrpm	800 ± 30	825 ± 25	750 ± 100	750 ± 50
Maximum (no load) speedrpm	5200	-	5200	5200
Smoke test/opacityM ⁻¹ %	2.5	2.5	1.5	2.1
Static timing method	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	1.0 ± 0.03	0.02	1.0 ± 0.03	1.0 ± 0.03
Crankshaft positionmm [°]	[7] ATDC	TDC	[7] ATDC	[7] ATDC
Turbo type / ref / pressure	-	0.80 to 0.95 bar @ 3000rpm	-	-
Injection pump make	Diesel Kiki	-	Nippon Denso	Diesel Kiki
Injection pump part no.....	-	-	VE	-
Injector Make / type	Throttle type	-	Nippon Denso	Throttle type
Injector part no.....	Small	-	-	-
Injection type.....	MD077258 or 259	Mitsubishi Electronic	Indirect DPA	Indirect
Injection opening pressure, New [used]...bar	≥118 [108]	130	118 to 127	≥118 [108]
Glow plugs				
Maker	Bosch	Bosch	Bosch	Bosch
Type	0250 202 003	0250 202 003	0250 202 003	0250 202 003
Nominal rating.....V/A	12 / 8.5	12 / 8.5	11 / 18	12 / 8.5
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	1.0
Rear.....mm	1.0	-	2.0	1.0
Tyres - Saloon / Hatch.....Size	165x14; 185/70x14	185/65x14	-	-
- Estate / Van.....Size	-	-	185/70x14	215x15; 205x16
Pressure - front / rear - Saloon / Hatch...bar	2.0 / 2.1	2.1 / 2.1	-	-
- Estate / Van.....bar	-	-	2.2 / 2.0	1.6 / 2.0
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 1.5	1.0 ± 2.0	0.0 ± 3.0	1.0 to 4.5
Camber	22' ± 30'	0°30'	0°20' ± 30'	1° ± 30'
Castor	2° ± 30'	2°12'	2°10' ± 40'	2°57' ± 30' 5dr: 3°5'±30'
King pin inclination.....	13°55'	-	13°50'	8°
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 1.5 PW	3.0 ± 2.0	-2.0 ± 2.0	-
Camber	-45' ± 14'	-0°40' ± 30'	-0°30' ± 30'	-



MITSUBISHI

	Galant 1800 1988 to 1993	Carisma 1.9TD 1997 to 2000	Space Wagon 2.0TD 1995 to 1996	Shogun / Pajero 2.5 Turbo 1986 to 1991
Torque wrench settings				
Cylinder head - stage 1Nm	45	30 + 50°	90	103 to 112 C
- stage 2Nm	85	Loosen	slacken	113 to 122 H
- stage 3Nm	125	25	40	-
- stage 4Nm	-	+ 215°	+ 90°	-
- stage 5Nm	-	warm engine	+ 90°	-
- stage 6Nm	-	+ 120°	-	-
Big-end bearings.....Nm	49 to 51 N	45 N	20 + 90° N	45 to 48
Main bearings.....Nm	64 to 68	65	25 + 90°	74 to 83
Crankshaft pulley boltNm	108 to 127	120	118	108 to 127
Camshaft pulley boltNm	79 to 98	50	88	79 to 98
Flywheel [driveplate] bolt.....Nm	128 to 137	53	132	128 to 137
Front hubsNm	200 to 260	230	250	WSM
Rear hubsNm	-	175	230	WSM
Wheel nuts / boltsNm	90 to 110	100	100	100 to 120
Glow plugsNm	18	23	18	20
Clutch pressure plate boltsNm	15 to 21	15 to 22	22	15 to 22
Injection pump sprocket.....Nm	59 to 68	50	83	59 to 68
Injectors.....Nm	68	70	55	68
Injection pump mounting boltsNm	15 to 21	-	24	15 to 21
Injector pipe unions.....Nm	23 to 36	23	30	23 to 36
Capacities				
Engine oil & filter.....litres	5.6	5.3	5.1	5.9
Gearbox.....litres	1.8	1.8	1.8	2.2 ¹
Automatic transmissionlitres	-	-	-	7.2
Final drive.....litres	WT	WT	WT	Front: 1.1 ²
Cooling system.....litres	8.1	6.0	6.0	8.0 ³
Fuel tank.....litres	60	60	60	60

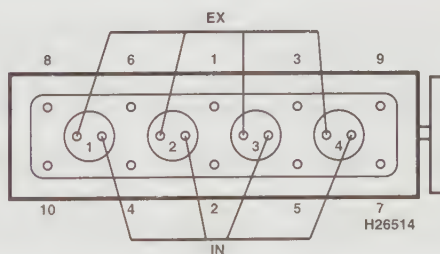
Notes

Shogun / Pajero 2.5 Turbo 1986 to 1991

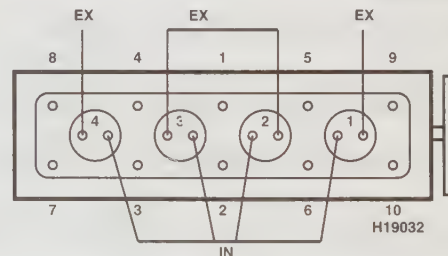
¹Transfer box: 2.2. Transfer box with PTO: 2.6

²Rear: 2.6

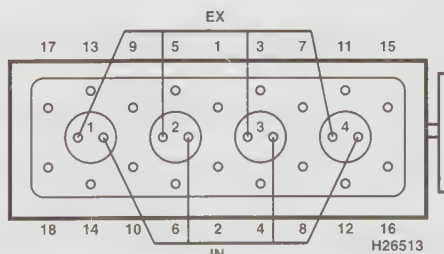
³With rear heater: 8.8



1795 cm³ / 1998 cm³



1870 cm³



2477 cm³

- Not applicable, or information not available



MITSUBISHI

	Shogun / Pajero 2.5 Turbo 1991 to 1997	Shogun 2.8TD 1994 to 2000	L200 & 4x4 Pick-up 1986 to 1996	L200 TD & 4x4 Pick-up 1992 to 1996
Engine				
Engine type/code.....	4D56T SOHC Turbo 72kW	4M40 SOHC Turbo 91kW	4D56 SOHC 51kW	4D56T SOHC Turbo 64kW
Capacity (cm ³) / cylinders.....	2477 / 4	2835 / 4	2477 / 4	2477 / 4
Compression ratio / pressure.....bar	21.0 / 19.0	21.0 / 29.0	21.0 / ≥19.2	21.0 / ≥19.2
Torque output.....Nm	240	291	147	240
Oil pressure.....idle [running] bar	2.0	0.9	0.76	0.76
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0.25 H	0.20	0.25 H	0.25 H
- exhaust (mm).....	0.25 H	0.30	0.25 H	0.25 H
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	F	TCE	F	F
Cooling system				
Thermostat opening temperature.....°C	82	76	82	76
Radiator cap pressure.....bar	0.76 to 1.04	0.7 to 1.0	0.76 to 1.04	0.76 to 1.04
Fuel system				
Idle speed.....rpm	750 ± 50	750 ± 100	750 ± 30	750 ± 30
Maximum (no load) speed.....rpm	5200	—	5200	5200
Smoke test/opacity.....M ⁻¹ %	2.1	2.0	2.5	2.5
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	1.0 ± 0.03	1.0	1.0 ± 0.03	1.0 ± 0.03
Crankshaft position.....mm [°]	[7] ATDC	[7] ATDC	[7] ATDC	[7] ATDC
Turbo type / ref / pressure.....bar	—	—	—	—
Injection pump make.....	Diesel Kiki	—	Diesel Kiki	Nippon Denso
Injection pump part no.....	—	VE Type	—	VE
Injector Make / type.....	Throttle type	Throttle type	Throttle type	Nippon Denso
Injector part no.....	—	Zexel	—	0010
Injection type.....	Indirect	Mechanical VE	MD0***	Indirect
Injection opening pressure, New [used]...bar	≥118 [108]	147 to 157	118 to 127 [108]	118 to 127 [108]
Glow plugs				
Maker.....	Bosch	—	Bosch	Bosch
Type.....	0250 202 003	K8T 75176	0250 202 003	0250 202 003
Nominal rating.....V/A	12 / 8.5	11 / 22	12 / 8.5	12 / 8.5
Brakes				
minimum friction material thickness				
Front.....mm	1.0	2.0	2.0	2.0
Rear.....mm	1.0	2.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	265/70x15	265/70x15; 235/75x15	185x14; 205x16	208/80x16
Pressure - front / rear - Saloon / Hatch...bar	—	—	—	—
- Estate / Van.....bar	1.6 / 1.9	1.6 / 1.9	1.8 / 2.2	1.8 / 1.8
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.8 ± 1.8	1.8 ± 1.8	1.0 to 4.5	1.0 to 4.5
Camber.....	0°40' ± 30'	0°40' ± 30'	40' ± 30' 4x4: 1°±30'	1°±30'
Castor.....	3° ± 1°	3° ± 1°	3° ± 1° 4x4: 2°±1°	2°±1°
King pin inclination.....	14°52'	14°52'	—	—
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.0	0.0	0	—
Camber.....	0'	0.0	0	—



MITSUBISHI

	Shogun / Pajero 2.5 Turbo 1991 to 1997	Shogun 2.8TD 1994 to 2000	L200 & 4x4 Pick-up 1986 to 1996	L200 TD & 4x4 Pick-up 1992 to 1996
Torque wrench settings				
Cylinder head - stage 1.....Nm	110	50	110	110
- stage 2.....Nm	-	+ 90°	-	-
- stage 3.....Nm	-	+ 90°	-	-
- stage 4.....Nm	-	M8: 24	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	47 N	50 + 90° N	45 to 47 N	45 to 47 N
Main bearings.....Nm	80	20 + 90° + 90°	74 to 83	74 to 83
Crankshaft pulley bolt.....Nm	190	230	135	190
Camshaft pulley bolt.....Nm	70	90	70	70
Flywheel [driveplate] bolt.....Nm	140	125	128 to 137	128 to 137
Front hubs.....Nm	WSM	WSM	WSM	WSM
Rear hubs.....Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	90	90	120 to 140	120 to 140
Glow plugs.....Nm	20	18	20	20
Clutch pressure plate bolts.....Nm	15 to 22	15 to 22	15 to 22	15 to 22
Injection pump sprocket.....Nm	85	65	59 to 68	85
Injectors.....Nm	60	50 to 60	68	68
Injection pump mounting bolts.....Nm	24	23	15 to 21	22
Injector pipe unions.....Nm	30	23	23 to 36	23 to 36
Capacities				
Engine oil & filter.....litres	6.7	7.8	6.8	6.8
Gearbox.....litres	2.5 ¹	2.5	2.3 4x4: 2.2 ¹	2.2 ¹
Automatic transmission.....litres	-	7.2	-	-
Final drive.....litres	Front: 1.1 ²	1.1 Rear: 3.2 ¹	1.8 ²	1.1 ²
Cooling system.....litres	9.5	9.5	7.3	7.3
Fuel tank.....litres	75	75 5dr: 95	69 4x4: 60	75

Notes

Shogun / Pajero 2.5 Turbo 1991 to 1997

¹Transfer box: 2.3

²Rear: 1.8

Shogun 2.8TD 1994 to 2000

¹Transfer box: 2.3

L200 & 4x4 Pick-up 1986 to 1996

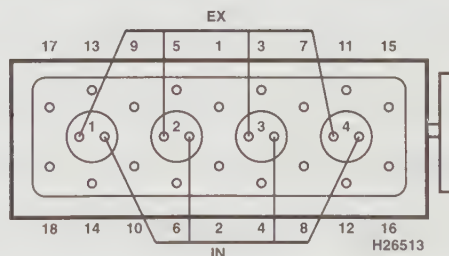
¹Transfer box: 2.2

²4x4: Front: 1.1. Rear: 2.1

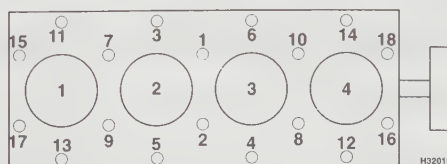
L200 TD & 4x4 Pick-up 1992 to 1996

¹Transfer box: 2.2

²Rear: 1.5

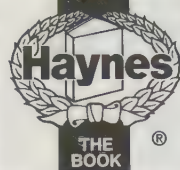


2477 cm³



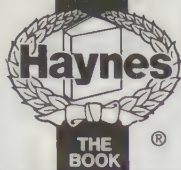
2835 cm³

- Not applicable, or information not available



MITSUBISHI

	L200 D 1996 to 2000	L200 TD 1996 to 2000	L300 1986 to 1996	L300 D 1996 to 2000
Engine				
Engine type/code.....	4D56 SOHC 55kW	4D56 SOHC Turbo 72kW	4D56 SOHC 51kW	4D56 SOHC 50kW
Capacity (cm ³) / cylinders.....	2477 / 4	2477 / 4	2477 / 4	2477 / 4
Compression ratio / pressurebar	21.0 / ≥19.2	21.0 / ≥19.2	21.0 / ≥19.2	21.0 / ≥19.2
Torque outputNm	150	240	147	147
Oil pressureidle [running] bar	—	—	0.76	—
Oil temperature°C	—	—	80	—
Valve clearances - inlet (mm)	0.25 H	0.25 H	0.25 H	0.25 H
- exhaust (mm)	0.25 H	0.25 H	0.25 H	0.25 H
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	F	TBE
Cooling system				
Thermostat opening temperature°C	88	76.5	82	82
Radiator cap pressurebar	0.75 to 1.05	0.75 to 1.05	0.76 to 1.04	0.75 to 1.05
Fuel system				
Idle speedrpm	750 ± 30	750 ± 50	750 ± 50	750 ± 30
Maximum (no load) speedrpm	5200	5200	5200	5200
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.1	2.1
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	1.0 ± 0.03	1.0 ± 0.03	1.0 ± 0.03	1.0 ± 0.03
Crankshaft positionmm [°]	[9] ATDC	[9] ATDC	[7] ATDC	[7] ATDC
Turbo type / ref / pressurebar	—	—	—	—
Injection pump make	—	—	Diesel Kiki	Bosch
Injection pump part no.....	VE Rotary	VE Rotary	—	VE Rotary
Injector Make / type.....	Bosch	Bosch	Throttle type	Throttle type
Injector part no.....	9430 610 120	9430 610 120	0010	—
Injection type.....	Indirect	Indirect	Indirect	Indirect
Injection opening pressure, New [used]...bar	147 to 157	147 to 157	118 to 127	118 to 127
Glow plugs				
Maker	Champion	Champion	Bosch	Bosch
Type	CH94	CH94	0250 202 003	0250 202 003
Nominal rating.....V/A	—	—	12 / 8.5	—
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185x15	205/80x16	185x14	185x14
Pressure - front / rear - Saloon / Hatch...bar	—	—	—	—
- Estate / Vanbar	1.8 / 2.2	1.8 / 1.8	3.0 / 3.0	3.0 / 3.0
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 to 4.5	1.0 to 4.5	0 to 3.0	0.0 to 3.0
Camber	0°40' ± 30'	1° ± 30'	31' ± 30'	0°30' ± 45'
Castor	3° ± 1°	2° ± 1°	3°8' ± 30'	3° ± 1°
King pin inclination.....	—	—	—	—
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	—	—	—	—
Camber	—	—	—	—



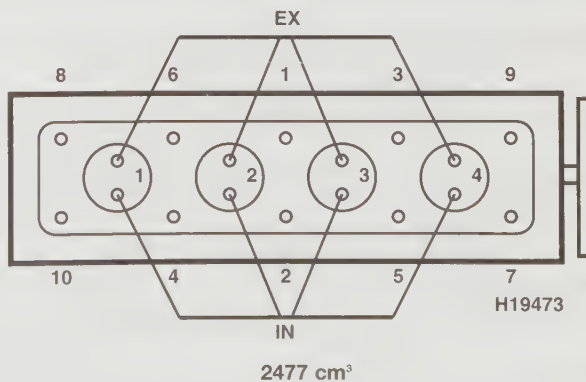
MITSUBISHI

	L200 D 1996 to 2000	L200 TD 1996 to 2000	L300 1986 to 1996	L300 D 1996 to 2000
Torque wrench settings				
Cylinder head - stage 1	Nm 40	40	40	40
- stage 2	Nm 80	80	80	80
- stage 3	Nm 120	120	110	110
- stage 4	Nm -	-	-	-
- stage 5	Nm -	-	-	-
- stage 6	Nm -	-	-	-
Big-end bearings	Nm 47 N	47 N	45 to 47 N	47 N
Main bearings	Nm 80	80	74 to 83	80
Crankshaft pulley bolt	Nm 175	180	190	190
Camshaft pulley bolt	Nm 70	70	70	70
Flywheel (driveplate) bolt	Nm 135	135	140	135
Front hubs	Nm WSM	-	30, slacken, 8	WSM
Rear hubs	Nm -	-	WSM	-
Wheel nuts / bolts	Nm 130	130	120 to 140	130
Glow plugs	Nm 18	18	20	20
Clutch pressure plate bolts	Nm 20	20	15 to 22	20
Injection pump sprocket	Nm 88	85	90	85
Injectors	Nm 55	55	60	55
Injection pump mounting bolts	Nm -	24	15 to 21	-
Injector pipe unions	Nm 30	30	23 to 36	30
Capacities				
Engine oil & filter	litres 6.8	6.8	6.8	6.8
Gearbox	litres 2.3	2.2	2.0	2.0
Automatic transmission	litres -	-	-	-
Final drive	litres 1.5	1.1 Rear: 1.5 ¹	1.2	1.2
Cooling system	litres 7.3	7.3	8.7	8.7
Fuel tank	litres 69	75	55	55

Notes

L200 TD 1996 to 2000

¹ Transfer: 2.2





NISSAN

	Micra 1.5 Diesel 1998 to 2000	Sunny 1.7 (B12, N13) 1986 to 1991	Sunny 2.0 D 1993 to 1995	Almera 2.0 D 1995 to 2000
Engine				
Engine type/code	VJZ SOHC 42kW	CD17 SOHC 40kW	CD20 SOHC 55kW	CD20E SOHC 55kW
Capacity (cm ³) / cylinders	1527 / 4	1681 / 4	1974 / 4	1974 / 4
Compression ratio / pressure	23 / ≥25.0	22.2 (N13: 21.8) / ≥19.6	22.2 / 31.4	22.2 / ≥24.5
Torque output	95	0	132	132
Oil pressureIdle [running] bar	0.59 [3.0]	[3.7 to 4.1]	0.59 [2.9 @ 2000]	0.59 [2.9]
Oil temperature°C	80	-	80	80
Valve clearances - inlet (mm)	0.07 to 0.23	0.20 to 0.30 H	0: Hyd.	0: Hyd.
- exhaust (mm)	0.22 to 0.38	0.40 to 0.50 H	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	88	82	88	88
Radiator cap pressure	1.1 to 1.5	0.78 to 0.98	0.78 to 0.98	0.8 to 1.0
Fuel system				
Idle speedrpm	800 ± 25	750 +100 -0 [850 +100 -0]	750 ± 50	715 ± 25
Maximum (no load) speedrpm	5450 ± 125	5500	5200 to 5500	5400
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method	Refer to wsm	Plunger travel	Plunger travel	Plunger travel
Timing dimension	-	0.88 ± 0.03	0.79 to 0.85	0.78 to 0.89
Crankshaft positionmm [°]	TDC	0 TDC	[9] ATDC	[8] ATDC
Turbo type / ref / pressure	-	-	-	-
Injection pump make	Bosch	Diesel Kiki	Diesel Kiki	Bosch
Injection pump part no.	VE4/8F 16700 6F901	16700-16A60 or 70 [16A65 or 75]	VE LNP 865	NP-VE4
Injector Make / type	Bosch	Pintle	Bosch	-
Injector part no.	-	-	9430 610 098	KV 11257800
Injection type	Indirect VE4	Bosch-VE	Indirect	ECCS-D
Injection opening pressure, New [used]...bar	115 to 125	≥132 [122]	127 to 135 [120 to 132]	132.4 to 140.2 [122.6 to 132.]
Glow plugs				
Maker	NGK	Bosch	Beru	-
Type	-	0250 202 005	685 MJ	-
Nominal rating	V/A	-	-	12 24
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	1.0
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	155/70x13	155x13: 175/70x13	155x13: 175/70x13	185/65x14
Pressure - front / rear - Saloon / Hatch...bar	-	155x13: 175/70x13	-	-
- Estate / Van.....bar	2.2 / 1.9	2.1 / 2.1	2.1 / 1.9	2.3 / 2.1
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-0.5 to 1.5	-0.5 to 1.5	[0°6']	0.0 to 0.4
Camber	-26' to 1°4'	-50' to 40'	-1° to 30'	-1°20' to 0°10'
Castor	1°31' to 3°1'	35' to 2°5'	0°40'	0°40' to 2°10'
King pin inclination.....	-	13°5' to 14°35'	13°15'	14°00' to 15°30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-0.5 to 1.5	0 to -4.0	[0°18']	-3 to 5
Camber	-26' to 1°4'	-1°45' to -15' [B12: to -25']	-1°40'	-1°45' to -0°15'



NISSAN

Micra 1.5 Diesel
1998 to 2000

Sunny 1.7 (B12, N13)
1986 to 1991

Sunny 2.0 D
1993 to 1995

Almera 2.0 D
1995 to 2000

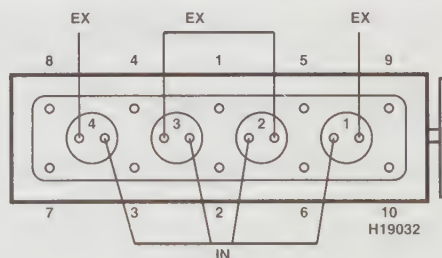
Torque wrench settings

Cylinder head - stage 1	Nm	40 N	59 to 69	39	39
- stage 2	Nm	265°	98 to 108	90	83 to 93
- stage 3	Nm	-	-	slacken	slacken
- stage 4	Nm	-	-	39	39
- stage 5	Nm	-	-	+ 80°	75° to 80°
- stage 6	Nm	-	-	-	-
Big-end bearings	Nm	40 N	29 to 37	16 + 60° N	15 + 60° to 65° N
Main bearings	Nm	20 + 50°	44 to 54	50	69 to 78
Crankshaft pulley bolt	Nm	110	123 to 132	150	152
Camshaft pulley bolt	Nm	80	92 to 102	100	107
Flywheel [driveplate] bolt	Nm	65	98 to 108	90	83 to 93
Front hubs	Nm	148 to 205	196 to 275	196 to 275	195 to 275
Rear hubs	Nm	186 to 255	186 to 255	186 to 255	WSM
Wheel nuts / bolts	Nm	98 to 118	98 to 118	98 to 118	100 to 120
Glow plugs	Nm	25	15 to 20	20	20
Clutch pressure plate bolts	Nm	-	22 to 29	30	22 to 29
Injection pump sprocket	Nm	25	59 to 69	65	65
Injectors	Nm	55	59 to 69	65	59 to 69
Injection pump mounting bolts	Nm	20	13 to 18	-	55
Injector pipe unions	Nm	20	22 to 25	25	25

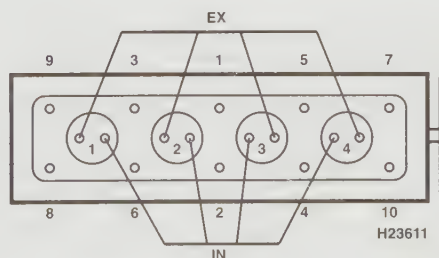
Capacities

Engine oil & filter	litres	4.4	3.8	5.4	5.2
Gearbox	litres	1.8 to 2.0	2.7 [2.8]	2.9	2.9 to 3.2
Automatic transmission	litres	-	6.3	-	-
Final drive	litres	WT	WT	WT	WT
Cooling system	litres	6.25	6.5	6.0	5.2
Fuel tank	litres	50	B12: 52 N13: 50	50	50

Notes



1527 cm³



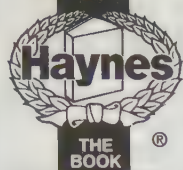
1681 cm³ / 1974 cm³

- Not applicable, or information not available



NISSAN

	Bluebird 2.0 Estate (U11) 1986 to 1991	Bluebird 2.0 (T12/72) 1986 to 1991	Primera 2.0 (P10) 1991 to 1996	Primera 2.0 TD (P11) 1998 to 1999
Engine				
Engine type/code.....	LD 20 SOHC 49kW	LD 20 SOHC 49kW	CD20 SOHC 55kW	CD20T SOHC Turbo 66kW
Capacity (cm ³) / cylinders.....	1952 / 4	1952 / 4	1974 / 4	1974 / 4
Compression ration / pressurebar	22.2 / 24.5	22.2 / 24.5	22.2 / ≥24.5	22.2 / ≥24.5
Torque outputNm	0	0	132	177
Oil pressureidle [running] bar	[2.9]	[2.9]	0.6 [2.9]	0.59 [2.9]
Oil temperature°C	—	—	80	80
Valve clearances - inlet (mm).....	0.25 H	0.25 H	0: Hyd.	0: Hyd.
- exhaust (mm).....	0.30 H	0.30 H	0: Hyd.	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	82	82	88	82
Radiator cap pressurebar	0.88	0.78 to 0.98	0.78 to 0.98	0.78 to 0.98
Fuel system				
Idle speedrpm	700 ± 50	700 ± 50	700 +50 -0 [800 +50 -0]	725 ± 25
Maximum (no load) speedrpm	5500	5600	5200 to 5500	5400
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	3.0
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	0.73 ± 0.04	0.73 ± 0.04	0.79 to 0.85	0.82 ± 0.07
Crankshaft positionmm [°]	0 TDC	0 TDC	0 TDC	[8] ATDC
Turbo type / ref / pressurebar	—	—	—	—
Injection pump make.....	Diesel Kiki	Diesel Kiki	Diesel Kiki	Bosch
Injection pump part no.....	16700-05E20	16700-05E20	16700-57J00, 10,05, 15 or 60J00	NP-VE4
Injector Make / type.....	—	Pintle	Bosch	Bosch
Injector part no.....	KV11257800	KV11257800	105780	DNOSD1510
Injection type.....	Bosch-VE	Bosch-VE	Bosch-VE	Electronic control
Injection opening pressure, New [used]...bar	≥132 [122]	≥132 [122]	128 to 135 [123 to 132]	150 to 160 [144.2 to 156.5]
Glow plugs				
Maker.....	Beru	Beru	—	—
Type.....	888 MJ	888 MJ	—	—
Nominal rating.....V/A	6.5 / 11	6.5 / 11	—	—
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	1.5	1.5	1.5 Discs: 2.0	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185/70x14; 195/60x15	—	—	—
Pressure - front / rear - Saloon / Hatch...bar	—	1.9 / 1.8	2.3 / 2.1	2.4 / 2.2
- Estate / Vanbar	1.9 / 1.9	—	—	—
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 to 3.0	1.0 to 3.0	0 to 2.0	0.0 to 2.0
Camber.....	-20' to 1°10'	-25' to 1°5'	-45' to 45'	-45' to 45'
Castor.....	1°15' to 2°45'	1°20' to 2°50'	1° to 2°30'	1° to 2°30'
King pin inclination.....	13°45' to 15°15'	13°50' to 15°20'	13°45' to 15°15'	13°45' to 15°15'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-6.0 to -2.0	-6.0 to -2.0	-2.0 to 2.0	-3.0 to 5.0
Camber.....	-1°10' to 20'	-1°10' to 20'	-1°45' to -15'	-1°45' to -15'



NISSAN

	Bluebird 2.0 Estate (U11) 1986 to 1991	Bluebird 2.0 (T12/72) 1986 to 1991	Primera 2.0 (P10) 1991 to 1996	Primera 2.0 TD (P11) 1998 to 1999
Torque wrench settings				
Cylinder head - stage 1	Nm 78	78	39	34 to 44
- stage 2	Nm 118 to 127	118 to 127	88 ± 5	93 to 103
- stage 3	Nm -	-	Slacken	Slacken
- stage 4	Nm -	-	39	31 to 37
- stage 5	Nm -	-	+ 75° to 80°	+ 90° to 95°
- stage 6	Nm -	-	-	+ 90° to 95°
Big-end bearings	Nm 44 to 54 N	44 to 54	15 + 60° N	15 + 60° N
Main bearings	Nm 69 to 83	69 to 83	54	69 to 78
Crankshaft pulley bolt	Nm 137 to 157	137 to 157	142 to 152	152
Camshaft pulley bolt	Nm 132 to 142	132 to 142	87 to 107	107
Flywheel [driveplate] bolt	Nm 137 to 157	137 to 157	83 to 93	83 to 93
Front hubs	Nm 235 to 314	235 to 314	235 to 314	235 to 314
Rear hubs	Nm WSM	WSM	186 to 255	186 to 255
Wheel nuts / bolts	Nm 78 to 98	98 to 118	98 to 118	98 to 118
Glow plugs	Nm 20 to 25	20 to 25	20 to 29	20
Clutch pressure plate bolts	Nm 18 to 22	18 to 22	22 to 29	22 to 29
Injection pump sprocket	Nm 59 to 69	59 to 69	59 to 69	65
Injectors	Nm 59 to 69	59 to 69	59 to 69	60 to 70
Injection pump mounting bolts	Nm 29 to 39	29 to 39	13 to 18 ¹	27
Injector pipe unions	Nm 22 to 25	22 to 25	22 to 25	25
Capacities				
Engine oil & filter	litres 4.2	4.3	5.5	4.7
Gearbox	litres 2.8	4.7	2.9	3.6 to 3.8
Automatic transmission	litres 6.8	-	7.0	-
Final drive	litres WT	WT	WT	WT
Cooling system	litres 6.2	7.0	6.6	6.6
Fuel tank	litres 53	60	60	60

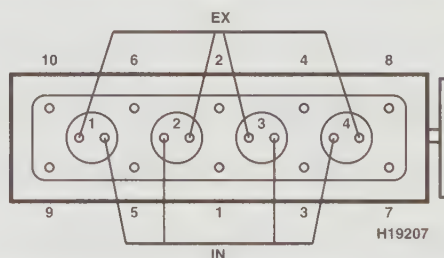
Notes

Bluebird 2.0 (T12/72) 1986 to 1991

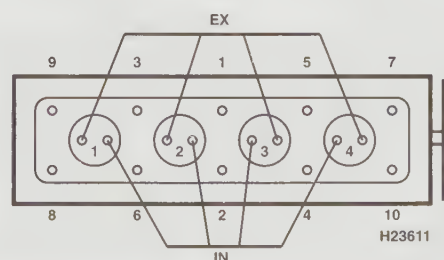
¹T72: 14°15' to 15°45'

Primera 2.0 (P10) 1991 to 1996

¹Bolt: 45 to 60



1952 cm³



1974 cm³

- Not applicable, or information not available



NISSAN

	Serena 2.0 D (C23) 1993 to 1995	Serena 2.3 D (C23) 1995 to 2000	Terrano II (R20) 1993 to 1996	Terrano II (R20) 1996 to 2000
Engine				
Engine type/code.....	LD20 SOHC 49kW	LD23 SOHC 55kW	TD27T OHV Turbo 74kW	TD27T OHV Turbo 91kW
Capacity (cm ³) / cylinders.....	1952 / 4	2283 / 4	2663 / 4	2663 / 4
Compression ratio / pressure.....bar	21.2 / ≥24.5	22.2 / ≥24.5	21.9 / ≥24.5	21.9 / ≥24.5
Torque output.....Nm	0	145	278	278
Oil pressure.....idle [running] bar	[2.9 @ 2000]	1.0 [3.0 @ 2000rpm]	≥0.78 [2.9 to 3.9 @ 3000]	≥0.78 [2.9 to 3.9 @ 3000]
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0.25 H	0.25 H	0.25 H	0.25 H
- exhaust (mm).....	0.30 H	0.30 H	0.25 H	0.25 H
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	F	F
Cooling system				
Thermostat opening temperature.....°C	82	82	82 or 88	82 or 88
Radiator cap pressure.....bar	0.78 to 0.98	0.78 to 0.98	0.78 to 0.98	0.78 to 0.98
Fuel system				
Idle speed.....rpm	700 ± 50	700 ± 50	700 ± 50 A/C: 850 ± 50	700 ± 50 A/C: 850 ± 50
Maximum (no load) speed.....rpm	5200	5200	5050 ± 100	5050 ± 100
Smoke test/opacity.....M ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	0.73 ± 0.01	0.69 ± 0.01	0.38 ± 0.02	0.27 ± 0.02
Crankshaft position.....mm [°]	[6]	0	0 TDC	0 TDC
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	Kiki Bosch	Kiki Bosch	Diesel Kiki	Diesel Kiki
Injection pump part no.....	VE 4/9 R1038	14749 2562	104645 4032	NP-VE4 RNP11
Injector Make / type.....	Bosch	Bosch	Bosch	Bosch
Injector part no.....	105780 2150	NP-DNOSD1510	-	NP-DNOSD1510
Injection type.....	Indirect	Indirect VE	Indirect	Indirect
Injection opening pressure, New [used]...bar	132 to 140 [123]	110 to 120 [100 to 110]	103 to 123 [98 to 103]	103 to 123 [98 to 103]
Glow plugs				
Maker.....	-	Champion	Beru	Champion
Type.....	-	CH187	854 MJ	CH162
Nominal rating.....V/A	11 / 8	11 / 17	11 / 17	11 /
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	1.5	1.5	1.52	1.52
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175x14	175x14	235/75x15	235/75x15
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Van.....bar	2.5 / 2.5	2.5 / 2.5	1.9 / 2.5	1.9 / 2.5
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0	2.0	3.0 to 5.0	3.0 to 5.0
Camber.....	-0°15' to 1°15'	-0°15' to 1°15'	35' ± 30'	35' ± 30'
Castor.....	3°28' ± 45'	3°28' ± 45'	1°40' ± 30'	1°40' ± 30'
King pin inclination.....	-	-	7°36' to 8°36'	7°36' to 8°36'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.8 to 1.8	-	-	-
Camber.....	-0°57' to 0°33'	-	-	-



NISSAN

	Serena 2.0 D (C23) 1993 to 1995	Serena 2.3 D (C23) 1995 to 2000	Terrano II (R20) 1993 to 1996	Terrano II (R20) 1996 to 2000
Torque wrench settings				
Cylinder head - stage 1	Nm 39	100	39 to 44	39 to 44
- stage 2	Nm 127	+ 90°	54 to 59	54 to 59
- stage 3	Nm slacken	+ 90°	+ 90 ± 10°	+ 90 ± 10°
- stage 4	Nm 39	-	-	-
- stage 5	Nm + 100°	-	-	-
- stage 6	Nm -	-	-	-
Big-end bearings	Nm 16 + 65°	52 to 58 N	78 to 83 N	78 to 83 N
Main bearings	Nm 80	15 + 60°	167 to 177	167 to 177
Crankshaft pulley bolt	Nm 157	152	294 to 324	294 to 324
Camshaft pulley bolt	Nm 142	142	44 to 49	44 to 49
Flywheel [driveplate] bolt	Nm 157	157	147 to 167	147 to 167
Front hubs	Nm 206 to 284	206 to 284	WSM	WSM
Rear hubs	Nm WSM ¹	WSM	WSM	WSM
Wheel nuts / bolts	Nm 98 to 118	98 to 118	118 to 147	118 to 147
Glow plugs	Nm 25	25	15 to 20	15 to 20
Clutch pressure plate bolts	Nm 22 to 29	22 to 29	22 to 29	22 to 29
Injection pump sprocket	Nm 65	65	59 to 69	59 to 69
Injectors	Nm 60 to 70	60 to 70	54 to 64	54 to 64
Injection pump mounting bolts	Nm 35	25	30 to 41	32 to 42 Nuts: 20 to 25
Injector pipe unions	Nm 25	25	20 to 25	20 to 25
Capacities				
Engine oil & filter	litres 5.7	7.0	7.2	7.2
Gearbox	litres 2.1	2.1	3.5 Transfer box: 2.3	3.5 Transfer box: 2.3
Automatic transmission	litres -	-	8.5	8.5
Final drive	litres 1.5	1.5 7.96 1.3	Rear: 1.3 LSD: 2.8	Rear: 1.3 LSD: 2.8
Cooling system	litres 11.5	13.7	10.0	10.0
Fuel tank	litres 60	60	3D: 72 5D: 80	3D: 72 5D: 80

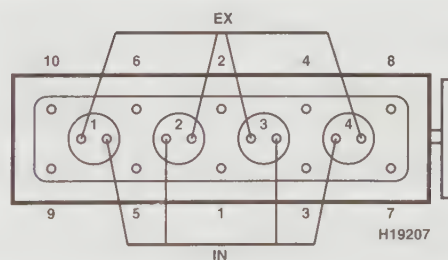
Notes

Serena 2.0 D (C23) 1993 to 1995

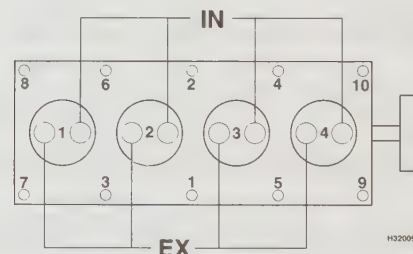
¹IRS type: 206 to 275

Terrano II (R20) 1996 to 2000

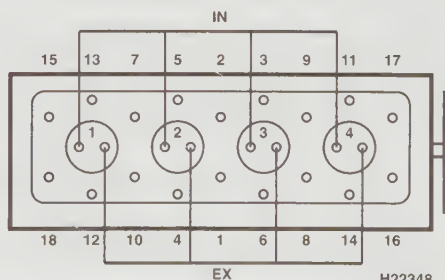
¹With intercooler



1952 cm³



2283 cm³



2663 cm³

- Not applicable, or information not available



NISSAN

	Patrol 2.8 1989 to 1993	Patrol 2.8 Turbo 1989 to 1993	Patrol GR (Y61) 1995 to 2000	Patrol 4.2 D 1993 to 1995
Engine				
Engine type/code.....	RD28 SOHC 66kW	RD28T SOHC Turbo 85kW	RD28ET SOHC Turbo 96kW	TD42 OHV 91kW
Capacity (cm ³) / cylinders.....	2826 / 6	2826 / 6	2826 / 6	4169 / 6
Compression ratio / pressure.....bar	21.2 / ≥24.5	21.2 / ≥24.5	21.8 / ≥24.5	22.7 / 29.4
Torque output.....Nm	0	235	252	272
Oil pressure.....idle [running] bar	[3.1 to 4.3 @ 2000]	[3.2 to 4.3]	0.78 [4.0 @ 3000rpm]	0.78 [2.9 to 3.9 @ 3000]
Oil temperature.....°C	80	—	80	80
Valve clearances - inlet (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0.35 H
- exhaust (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0.35 H
Injection order.....	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-4-2-5-3-6
No. 1 cylinder position.....	TCE	TCE	F	—
Cooling system				
Thermostat opening temperature.....°C	82	82	82	82
Radiator cap pressure.....bar	0.78 to 0.98	0.78 to 0.98	0.78 to 0.98	0.78 to 0.98
Fuel system				
Idle speed.....rpm	600 ± 50	650 ± 50	650 ± 25	700 to 750
Maximum (no load) speed.....rpm	5000 ± 100	4600 ± 100	5200	4600 ± 100
Smoke test/opacity.....M ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	0.75 ± 0.03	0.86 ± 0.05	0.92 ± 0.04	0.74 ± 0.02
Crankshaft position.....mm [°]	0 TDC	0 TDC	0 TDC	0 TDC
Turbo type / ref / pressure.....bar	—	—	—	—
Injection pump make.....	Diesel Kiki	Diesel Kiki	Diesel Kiki	Diesel Kiki
Injection pump part no.....	16700-C9600	16700-22J00	VE	104760 4300
Injector Make / type.....	Diesel Kiki	Diesel Kiki	Bosch	Bosch
Injector part no.....	KV 112 57800	KV 112 57800	9430 610 033	105780
Injection type.....	Bosch-VE	Bosch-VE	Indirect	Indirect
Injection opening pressure, New [used]...bar	132 to 140 [122]	132 to 140 [122]	132 to 140 9123 to 132]	103 to 113 [98]
Glow plugs				
Maker.....	Beru	Beru	Beru	Champion
Type.....	636 MJ	636 MJ	636 MJ	CH162
Nominal rating.....V/A	—	—	—	11 /
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	1.5	1.5	2.0	2.0
Tyres - Saloon / Hatch.....Size	—	—	—	—
- Estate / Van.....Size	205x16	205/70x16	265/70x16	265/70x15
Pressure - front / rear - Saloon / Hatch...bar	—	—	—	—
- Estate / Van.....bar	1.8 / 2.4	1.8 / 2.4	2.0 / 2.8	2.0 / 2.8
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 2.0	0 ± 2.0	1.0 ± 1.0	[0°14']
Camber.....	30' ± 30'	30' ± 30'	0° ± 30'	0°
Castor.....	3°35' ± 30' Hardtop: 3°15'±30	3°35' ± 30' Hardtop: 3°15'±30	3°50' 5dr: 3°30'	2°05'
King pin inclination.....	7°30' ± 30'	7°30' ± 30'	14°30'	7°
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	—	—	—	—
Camber.....	—	—	—	—



NISSAN

	Patrol 2.8 1989 to 1993	Patrol 2.8 Turbo 1989 to 1993	Patrol GR (Y61) 1995 to 2000	Patrol 4.2 D 1993 to 1995
Torque wrench settings				
Cylinder head - stage 1Nm	29	29	29	44
- stage 2Nm	113	113	113	60
- stage 3Nm	Slacken	Slacken	Slacken	+ 90°
- stage 4Nm	29	29	29	-
- stage 5Nm	+ 100°	+ 100°	127	-
- stage 6Nm	M8 bolts: 16 to 21	M8 bolts: 16 to 21	M8: 19	-
Big-end bearings.....Nm	16, 45	16, 45 N	15, 40 N	80 N
Main bearings.....Nm	69 to 78	69 to 78	72	177
Crankshaft pulley boltNm	142 to 152	142 to 152	152	324
Camshaft pulley boltNm	123 to 132	123 to 132	132	83
Flywheel [driveplate] bolt.....Nm	137 to 157	137 to 157	145	167
Front hubsNm	167 to 196	167 to 196	WSM	196, slacken, 5
Rear hubsNm	441 to 490	441 to 490	WSM	490
Wheel nuts / boltsNm	118 to 147	118 to 147	118 to 147	130
Glow plugsNm	15 to 20	15 to 20	20	20
Clutch pressure plate boltsNm	22 to 29	22 to 29	10, 26	30
Injection pump sprocket.....Nm	54 to 64	54 to 64	64	69
Injectors.....Nm	59 to 69	59 to 69	60 to 70	64
Injection pump mounting boltsNm	16 to 21	16 to 21	21	41
Injector pipe unions.....Nm	22 to 25	22 to 25	25	25
Capacities				
Engine oil & filter.....litres	6.7	6.7	6.4	6.7
Gearbox.....litres	3.6 ¹	3.6 ¹	5.1	3.9 ¹
Automatic transmissionlitres	-	-	-	-
Final drivelitres	Front: 1.3 ²	Front: 1.3 ²	5.1 Rear: 2.1 ¹	5.4 Rear: 2.1
Cooling system.....litres	12.9	12.9	11.8	12.9
Fuel tank.....litres	82	82	95	95

Notes

Patrol 2.8 1989 to 1993

¹Transfer box: 1.9

²Rear: 1.9

Patrol 2.8 Turbo 1989 to 1993

¹Transfer box: 1.9

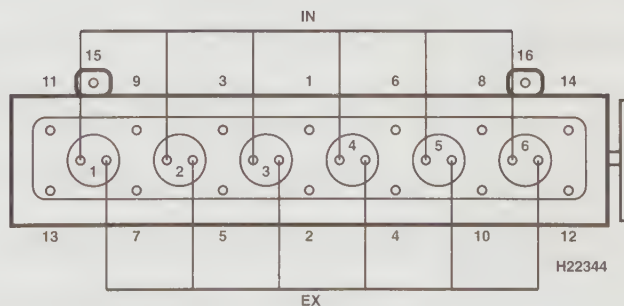
²Rear: 1.9

Patrol GR (Y61) 1995 to 2000

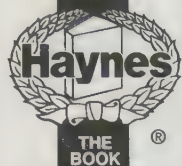
¹Transfer box: 1.9

Patrol 4.2 D 1993 to 1995

¹Transfer: 1.9



2826 cm³



NISSAN

	Pick-up 2.5 (D21) 1990 to 1998	Pick-up (D22) 2.5 TD 1998 to 2000	Vanette 2.0 (C22) 1986 to 1996	Vanette 2.3 D (HC23) 1995 to 2000
Engine				
Engine type/code.....	TD25 OHV 55kW	TD25 OHV 55kW	LD20 SOHC 44kW	LD23 SOHC 55kW
Capacity (cm ³) / cylinders.....	2494 / 4	2494 / 4	1995 / 4	2283 / 4
Compression ratio / pressure.....bar	22.2 / 24.5	22.2 / ≥24.5	22.2 / 24.5	22.2 / 24.5
Torque output.....Nm	160	160	0	145
Oil pressure.....idle [running] bar	[2.9 to 3.9 @ 3000]	0.78 [3.0 @ 3000]	[2.9]	1.0 [3.0 @ 2000]
Oil temperature.....°C	80	80		80
Valve clearances - inlet (mm).....	0.35 H	0.3 to 0.4 H	0.25 H	0.25 H
- exhaust (mm).....	0.35 H	0.3 to 0.4 H	0.30 H	0.30 H
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	F		TBE	
Cooling system				
Thermostat opening temperature.....°C	82	82	82	82
Radiator cap pressure.....bar	0.78 to 0.98	0.78 to 0.98	0.78 to 0.98	0.78 to 0.98
Fuel system				
Idle speed.....rpm	700 ± 50	700 ± 50	700 ± 50	700 ± 50
Maximum (no load) speed.....rpm	5000 ± 100		5300	5000 ± 100
Smoke test/opacity.....M-1 %	2.5	2.5	2.5	2.5
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger lift
Timing dimension.....mm	0.71 ± 0.02	0.71 ± 0.02	0.73 ± 0.04	0.69 ± 0.04
Crankshaft position.....mm [°]	0 TDC	TDC	0 TDC	TDC
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	Diesel Kiki	Bosch	Diesel Kiki	Kia Bosch
Injection pump part no.....	16700-44G04 or G06	VE	16700-05E20	10749-2562
Injector Make / type.....	Diesel Kiki		Pintle	Diesel Kia
Injector part no.....	16600-43G02	-	KV11257800	DNQSD1510
Injection type.....	Bosch-VE		Bosch-VE	indirect
Injection opening pressure, New [used]...bar	103 to 112 [98 to 103]	[98.1 to 103]	≥132 [122]	110 to 120 [100]
Glow plugs				
Maker.....	Beru	Champion	Bosch	Champion
Type.....	921 MJ	CH162	0250 201 032	CH-57
Nominal rating.....V/A	-	11 /	-	-
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185x14; 195x14; 205x16	185x14 4x4; 205x16	165x14; 195 70x14	185 75x14
Pressure - front / rear - Saloon / Hatch...bar	-			
- Estate / Van.....bar	1.8 / 2.2	2.5 / 2.7 4x4; 2.5 / 2.8	3.0 / 3.0	Refer to vehicle
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 to 5.0'	3.0 ± 1.0 4x4; 4.0 ± 1.0	-1.0 to 3.0	-2.0
Camber.....	-28' to 1°22'	25' 4x4; 36'	-30' to 1°	-2°15' to 1°15'
Castor.....	-24' to 1°6°13'	22' 4x4; 2°20'	50' to 2°20'	3°28' ± 45'
King pin inclination.....	8°28' to 9°58°14'	9°5' 4x4; 10°48'	9° to 10°	
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-			
Camber.....	-	-		



NISSAN

	Pick-up 2.5 (D21) 1990 to 1998	Pick-up (D22) 2.5 TD 1998 to 2000	Vanette 2.0 (C22) 1986 to 1996	Vanette 2.3 D (HC23) 1995 to 2000
Torque wrench settings				
Cylinder head - stage 1	Nm 39 to 44	40	78	100
- stage 2	Nm 54 to 59	60	118 to 127	+ 90°
- stage 3	Nm + 90°	+ 90°	-	+ 90°
- stage 4	Nm -	-	-	-
- stage 5	Nm -	-	-	-
- stage 6	Nm -	-	-	-
Big-end bearings	Nm 78 to 83 N	80 N	44 to 54 N	55 N
Main bearings	Nm 167 to 177	170	69 to 83	15 + 60°
Crankshaft pulley bolt	Nm 294 to 324	324	137 to 157	152
Camshaft pulley bolt	Nm 49	50	132 to 142	142
Flywheel [driveplate] bolt	Nm 147 to 167	150	137 to 157	160
Front hubs	Nm 34 to 39°	-	265 to 353	250
Rear hubs	Nm -	-	-	-
Wheel nuts / bolts	Nm 118 to 147	130	98 to 118	105
Glow plugs	Nm 15 to 20	20	20 to 25	25
Clutch pressure plate bolts	Nm 22 to 30	25	18 to 22	25
Injection pump sprocket	Nm 59 to 69	70	59 to 69	69
Injectors	Nm 54 to 64	60	59 to 69	65
Injection pump mounting bolts	Nm 20 to 25	23	29 to 39	25
Injector pipe unions	Nm 20 to 25	25	22 to 25	25
Capacities				
Engine oil & filter	litres 6.0	6.0	4.1	7.0
Gearbox	litres 2.0 4x4: 4.0 ^a	2.0 4x4: 5.1	2.0	2.1
Automatic transmission	litres -	-	-	-
Final drive	litres 1.3 ^b	1.3 Transfer: 2.2	1.0	1.5
Cooling system	litres 10.4	80	7.7 ^c	13.7
Fuel tank	litres 60 or 80	80	55	60

Notes

Pick-up 2.5 (D21) 1990 to 1998

¹4x4: 2.0 to 6.0

²4x4: -9' to 1°21'

³4x4: 33' to 2°3'

⁴4x4: 7°20' to 8°50'

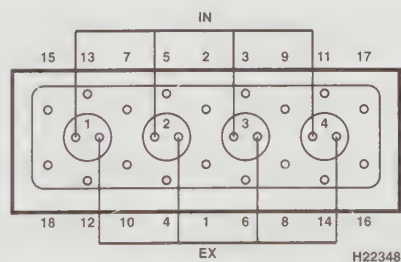
⁵4x4: 78 to 98

⁶4x4 transfer box: 2.2

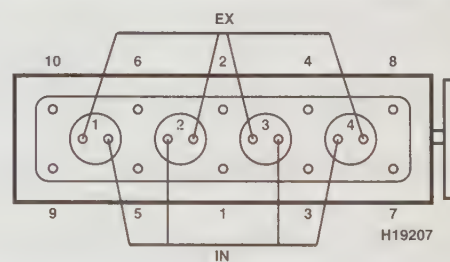
⁷4x4 rear: 2.8

Vanette 2.0 (C22) 1986 to 1996

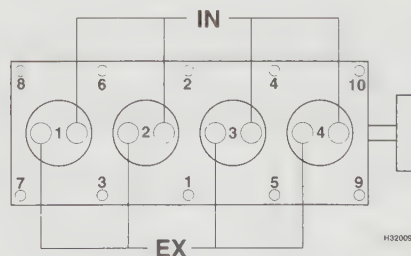
¹With front and rear heaters: 8.2



2494 cm³



1952 cm³



2283 cm³

– Not applicable, or information not available



NISSAN

	Urvan 2.5 (E24) 1990 to 1996	Cabstar 2.5 (F22) 1990 to 1992	Cabstar D (F23) 1993 to 1999	
Engine				
Engine type/code.....	TD25 OHV 55kW	TD25 OHV 55kW	TD25 OHV 55kW	
Capacity (cm ³) / cylinders.....	2494 / 4	2494 / 4	2494 / 4	
Compression ration / pressurebar	22.2 / 24.5	22.2 / 24.5	22.2 / ≥22.4	
Torque outputNm	160	160	160	
Oil pressureidle [running] bar	[3.0 @ 3000]	[2.9 to 3.9 @ 3000]	0.78 [3.0 @ 3000]	
Oil temperature°C	80	80	80	
Valve clearances - inlet (mm).....	0.35 H	0.35 H	0.35 H	
- exhaust (mm).....	0.35 H	0.35 H	0.35 H	
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	
No. 1 cylinder position.....	F	F	F	
Cooling system				
Thermostat opening temperature°C	82	82	82	
Radiator cap pressurebar	0.78 to 0.98	0.9	0.78 to 0.98	
Fuel system				
Idle speedrpm	700 ± 50	700 ± 50	850 ± 50	
Maximum (no load) speedrpm	5100	5050	4850 to 5050	
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	
Static timing method.....	Plunger travel	Plunger travel	Rotor lift	
Timing dimension.....mm	0.71 ± 0.02	0.71 ± 0.02	0.74 ± 0.02	
Crankshaft positionmm [°]	0 TDC	0 TDC	0 TDC	
Turbo type / ref / pressurebar	-	-	-	
Injection pump make.....	Diesel Kiki	Diesel Kiki	Bosch	
Injection pump part no.....	16700-30N05 or N08	16700-21T13	VE	
Injector Make / type.....	Diesel Kiki	Diesel Kiki	Diesel Kiki	
Injector part no.....	16600-43G02	16600-43G02	KV 11 257 800/802	
Injection type.....	Bosch-VE	Bosch-VE	Indirect	
Injection opening pressure, New [used]...bar	103 to 112 [100]	103 to 112 [100]	103 to 112 [98 to 103]	
Glow plugs				
Maker.....	Bosch	Bosch	Bosch	
Type.....	0250 202 060	0250 202 060	0250 202 060	
Nominal ratingV/A	-	11 / 10	11 / 10	
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	
Rear.....mm	1.5	1.5	1.5	
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185x14	205x16	205/75x16	
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	
- Estate / Vanbar	2.8 / 2.8	4.25 / 4.7	4.25 / 4.7	
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 to 2.0	0 to 2.0	[0° to 10°]	
Camber.....	-5' to 55'	-25' to 35'	-0°25' to 0°35'	
Castor.....	30' to 1°30'	30' to 1°30'	0°30' to 1°30'	
King pin inclination.....	8°35' to 9°35'	8°55' to 9°55'	8°55' to 9°55'	
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-	-	
Camber.....	-	-	-	



NISSAN

	Urvan 2.5 (E24) 1990 to 1996	Cabstar 2.5 (F22) 1990 to 1992	Cabstar D (F23) 1993 to 1999	
Torque wrench settings				
Cylinder head - stage 1.....Nm	39 to 44	39 to 44	42	
- stage 2.....Nm	54 to 59	54 to 59	56	
- stage 3.....Nm	+ 90°	+ 90°	+ 90°	
- stage 4.....Nm	-	-	-	
- stage 5.....Nm	-	-	-	
- stage 6.....Nm	-	-	-	
Big-end bearings.....Nm	78 to 83 N	78 to 83 N	80 N	
Main bearings.....Nm	167 to 177	167 to 177	170	
Crankshaft pulley bolt.....Nm	294 to 324	294 to 324	324	
Camshaft pulley bolt.....Nm	49	49	49	
Flywheel [driveplate] bolt.....Nm	147 to 167	147 to 167	155	
Front hubs.....Nm	34 to 39	34 to 39	40 + 45°	
Rear hubs.....Nm	-	WSM	-	
Wheel nuts / bolts.....Nm	118 to 147	118 to 147 ²	128	
Glow plugs.....Nm	15 to 20	15 to 20	20	
Clutch pressure plate bolts.....Nm	22 to 30	22 to 30	25	
Injection pump sprocket.....Nm	59 to 69	59 to 69	69	
Injectors.....Nm	54 to 64	54 to 64	60	
Injection pump mounting bolts.....Nm	20 to 25	20 to 25	-	
Injector pipe unions.....Nm	20 to 25	20 to 25	25	
Capacities				
Engine oil & filter.....litres	5.9	6.2	6.2	
Gearbox.....litres	2.0	2.7	2.0	
Automatic transmission.....litres	7.0	-	-	
Final drive.....litres	2.0	2.0	2.0	
Cooling system.....litres	13.0 ¹	13.8	13.8	
Fuel tank.....litres	65	65	64	

Notes

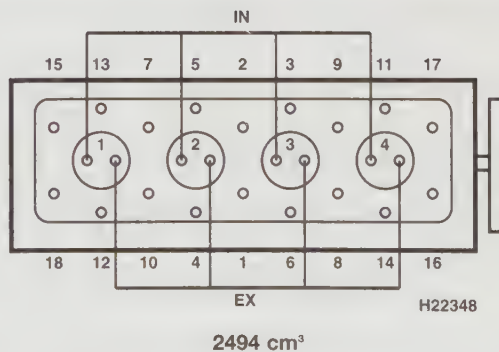
Urvan 2.5 (E24) 1990 to 1996

¹With rear heater: 14.0

Cabstar 2.5 (F22) 1990 to 1992

¹Twin rear tyre: 15' to 1¹/15'

²Twin rear tyre: 216 to 255

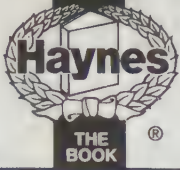


- Not applicable, or information not available



PEUGEOT

	106 1.4 D 1993 to 1994	106 1.4 D 1993 to 1994	106 1.5 D 1994 to 2000	106 1.5 D 1994 to 2000
Engine				
Engine type/code	TUD3Y K9Y SOHC 8V 37kW	TUD3/L K9B SOHC 8V 37kW	TUD5/L VJZ SOHC 8V 42kW	TUD5/Y/L3 VJY SOHC 8V 40kW
Capacity (cm ³) / cylinders	1360 / 4	1360 / 4	1527 / 4	1527 / 4
Compression ratio / pressure	22.5 /	22.5 /	23.0 /	23.0 /
Torque output	0	0	95	95
Oil pressureidle [running] bar	[4.0 @ 4000rpm]	[4.0 @ 4000rpm]	[4.0 @ 4000rpm]	[4.0 @ 4000rpm]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.15	0.15	0.20	0.20
- exhaust (mm)	0.30	0.30	0.40	0.40
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	89	89	89	89
Radiator cap pressure	1.4	1.4	1.4	1.4
Fuel system				
Idle speedrpm	775 ± 50	775 ± 50	775 ± 50	775 ± 50
Maximum (no load) speedrpm	5450	5450	5450	5450
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Plunger travel	Plunger travel	Refer to wsm	Refer to wsm
Timing dimension.....mm	Dimension on pump	Dimension on pump	-	Dimension on pump
Crankshaft positionmm [°]	-	-	-	-
Turbo type / ref / pressure	-	-	-	-
Injection pump make	Lucas	Lucas	Bosch	Lucas
Injection pump part no.....	R8443 B971B	R8443 B461C	537	R8444B480A
Injector Make / type	CAV	CAV	CAV	CAV
Injector part no.....	RDNOSDC6880C	RDNOSDC6863C	DNOS D299A/Lucas RDN 125DC6849	LDC007R01A
Injection type.....	Indirect DPC	Indirect DPC	Indirect	Indirect DPC
Injection opening pressure, New [used]...bar	122 to 132	122 to 132	130 to 135	130 to 135
Glow plugs				
Maker	Bosch/Champion	Bosch/Champion	Beru/Champion	Beru/Champion
Type	0250 202 001 / CH147	0250 202 001 / CH147	0100 226 188 / CH168	0100 226 188 / CH168
Nominal rating	11 / 12	11 / 12	11 / 16	11 / 16
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	165/70x13	165/70x13	165/70x13	165/70x13
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.2	2.2 / 2.2	2.2 / 2.2	2.2 / 2.2
- Estate / Vanbar	2.2 / 2.2	2.2 / 2.2	2.2 / 2.2	2.2 / 2.2
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-0.5 ± 0.5	-0.5 ± 0.5	-0.5 ± 0.5	-0.5 ± 0.5
Camber	-0°40' ± 30'	-0°40' ± 30'	-0°40' ± 30'	-0°40' ± 30'
Castor	2°13' ± 30'	2°13' ± 30'	2°13' ± 30'	2°13' ± 30'
King pin inclination.....	12°41' ± 40'	12°41' ± 40'	12°41' ± 40'	12°41' ± 40'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.5 ± 1.2	1.5 ± 1.2	1.5 ± 1.2	1.5 ± 1.2
Camber	-1°35' ± 30'	-1°35' ± 30'	-1°35' ± 30'	-1°35' ± 30'



PEUGEOT

	106 1.4 D 1993 to 1994	106 1.4 D 1993 to 1994	106 1.5 D 1994 to 2000	106 1.5 D 1994 to 2000
Torque wrench settings				
Cylinder head - stage 1.....Nm	20 N	20 N	40 ¹	40 ¹
- stage 2.....Nm	+ 160°	+ 160°	+ 260°	+ 260°
- stage 3.....Nm	+ 160°	+ 160°	-	-
- stage 4.....Nm	-	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	40 N	40 N	40 N	40 N
Main bearings.....Nm	20 + 45°	20 + 45°	20 + 50°	20 + 50°
Crankshaft pulley bolt.....Nm	90 to 130	90 to 130	110	110
Camshaft pulley bolt.....Nm	40 to 50	40 to 50	80	80
Flywheel [driveplate] bolt.....Nm	70 LcK	70 LcK	65 LcK	65 LcK
Front hubs.....Nm	260	260	245	260
Rear hubs.....Nm	140	140	140	140
Wheel nuts / bolts.....Nm	85	85	85	85
Glow plugs.....Nm	22	22	25	25
Clutch pressure plate bolts.....Nm	15	15	15	15
Injection pump sprocket.....Nm	-	-	25	25
Injectors.....Nm	90	90	55	55
Injection pump mounting bolts.....Nm	-	-	20	20
Injector pipe unions.....Nm	20	20	20	20
Capacities				
Engine oil & filter.....litres	3.5	3.5	4.50	4.50
Gearbox.....litres	2.0	2.0	2.0	2.0
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	6.0	6.0	6.0	6.0
Fuel tank.....litres	45	45	45	45

Notes

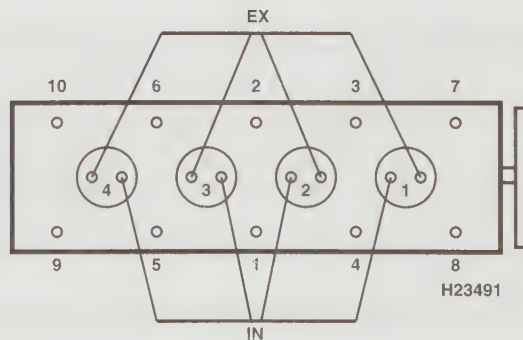
106 1.5 D 1994 to 2000

¹Bolt length below head: ≤197.5 mm

²or Lucas 070

106 1.5 D 1994 to 2000

¹Bolt length below head: ≤197.5 mm



1360 cm³ / 1527 cm³

- Not applicable, or information not available



PEUGEOT

	205 & Van 1.7 1983 to 1996	205 & Van 1.7 1983 to 1996	205 Turbo 1.7 1990 to 1996	205 1.9 1987 to 1994
Engine				
Engine type/code	XUD7 161A SOHC 44kW	XUD7 161A SOHC 44kW	XUD7T/L A8B SOHC Turbo 58kW	XUD9Y DJZ SOHC 47kW
Capacity (cm ³) / cylinders	1769 / 4	1769 / 4	1769 / 4	1905 / 4
Compression ratio / pressure	23.0 / _	23.0 / _	22.0 / _	23.5 / _
Torque output	108	108	157	120
Oil pressureidle [running] bar	2.0 [4.5 @ 4000]	2.0 [4.5 @ 4000]	2.0 [4.5 @ 4000]	2.0 [4.5 @ 4000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.15 ± 0.04	0.15 ± 0.04	0.15 ± 0.04	0.15 ± 0.04
- exhaust (mm)	0.30 ± 0.04	0.30 ± 0.04	0.30 ± 0.04	0.30 ± 0.04
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	83	83	89	88
Radiator cap pressurebar	1.0	1.0	1.4	1.0
Fuel system				
Idle speedrpm	800 ± 50	800 ± 50	800 ± 50	800 ± 50
Maximum (no load) speedrpm	5100	5100	4800	5100
Smoke test/opacityM ⁻¹ %	2.5	2.5	3.0	2.5
Static timing method.....	Plunger travel	Rotor groove	Dial gauge	Plunger travel
Timing dimension.....mm	0.3	0.01'	Value marked on pump	0.3
Crankshaft positionmm [°]	0.8 ± 0.03	2.26 ± 0.05'	TDC	0.57 ± 0.03
Turbo type / ref / pressurebar	-	-	KKK K14 0.67 bar @ 3500rpm	-
Injection pump make	Bosch	Roto Diesel	Roto Diesel	Bosch
Injection pump part no.....	2300 R143, R171	R8443 260A/052, A262D or B263D	R8443 B620A	VE R162/4
Injector Make / type	Bosch	Roto Diesel	Roto Diesel	Bosch
Injector part no.....	DNOSD 256	RDNOSDC 6850C	RDNOSDC 682D	0432 217 153
Injection type.....	Indirect VE4/18F	Indirect DPC	Indirect DPC	Indirect VER
Injection opening pressure, New [used]...bar	130	115	130	130 [117]
Glow plugs				
Maker	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type	0250 201 019 / CH68	0250 201 019 / CH68	0250 201 019 / CH68	0250 201 019 / CH68
Nominal rating.....V/A	11 / 12	11 / 12	11 / 13	11 12
Brakes				
minimum friction material thickness				
Front.....mm	1.0	1.0	1.0	1.0
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size	145x13: 155/70x13	145x13: 155/70x13	165/70x13	155/70x13: 165/70x13
- Estate / Van.....Size	145x13: 165/70x13	145x13: 165/70x13	-	-
Pressure - front / rear - Saloon / Hatch...bar	1.8 / 2.0	1.8 / 2.0	1.8 / 2.0	1.8 / 2.0
- Estate / Vanbar	1.9 / 2.1	1.9 / 2.1	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 ± 0.5 PW	1.0 ± 0.5 PW	1.0 ± 0.5 PW	1.0 ± 0.5 PW
Camber	0° ± 30'	0° ± 30'	0° ± 30'	0° ± 30'
Castor	3° ± 30'	3° ± 30'	3° ± 30'	3° ± 30'
King pin inclination.....	9°45' ± 30'	9°45' ± 30'	9°45' ± 30'	9°45' ± 30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.6 ± 0.8 PW	1.6 ± 0.8 PW	1.6 ± 0.8 PW	1.6 ± 0.8 PW
Camber	-50' ± 30'	-50' ± 30'	-50' ± 30'	-50' ± 30'



PEUGEOT

205 & Van 1.7
1983 to 1996

205 & Van 1.7
1983 to 1996

205 Turbo 1.7
1990 to 1996

205 1.9
1987 to 1994

Torque wrench settings

Cylinder head - stage 1	Nm	30 ¹	30 ²	30 N	30 N
- stage 2	Nm	60	60	70	70
- stage 3	Nm	Slacken, 60	Slacken, 60	+ 120°	+ 120°
- stage 4	Nm	Warm up, allow to cool	Warm up, allow to cool	-	-
- stage 5	Nm	Slacken	Slacken	-	-
- stage 6	Nm	70	70	-	-
Big-end bearings	Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings	Nm	70	70	70	70
Crankshaft pulley bolt	Nm	40 + 60°	40 + 60°	40 + 60°	40 + 60°
Camshaft pulley bolt	Nm	40	40	40	40
Flywheel [driveplate] bolt	Nm	50 LkC	50 LkC	50	50 LkC
Front hubs	Nm	265	265	265	265
Rear hubs	Nm	215	215	215	215
Wheel nuts / bolts	Nm	85	85	85	85
Glow plugs	Nm	22	22	22	22
Clutch pressure plate bolts	Nm	25	25	25	25
Injection pump sprocket	Nm	50	50	50	50
Injectors	Nm	90	90	90	90
Injection pump mounting bolts	Nm	-	-	-	-
Injector pipe unions	Nm	-	-	-	-

Capacities

Engine oil & filter	litres	4.75	4.75	4.75	4.75
Gearbox	litres	2.0	2.0	2.0	2.0
Automatic transmission	litres	-	-	-	-
Final drive	litres	WT	WT	WT	WT
Cooling system	litres	8.3	8.3	8.5	8.3
Fuel tank	litres	50	50	50	50

Notes

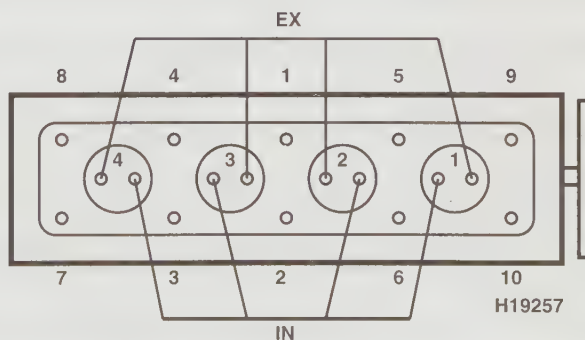
205 & Van 1.7 1983 to 1996

¹9.86 ►: 30, 70 + 120°

205 & Van 1.7 1983 to 1996

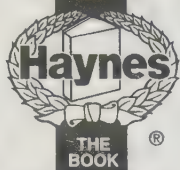
¹8443B263D: value shown on pump

²9.86 ►: 30, then 70 + 120°



1769 cm³ / 1905 cm³

- Not applicable, or information not available



PEUGEOT

	206 1.9 D 1998 to 2000	206 1.9 D 1999 to 2000	206 2.0 HDi 1999 to 2000	306 1.9 D 1993 to 1999
Engine				
Engine type/code.....	DW8/L3 WJZ 51kW	DW8B/L3 WJY 51kW	DW10TD/L3 RHY SOHC 66kW	XUD9A/L D9B SOHC 52kW
Capacity (cm ³) / cylinders.....	1868 / 4	1868 / 4	1997 / 4	1905 / 4
Compression ratio / pressure.....bar	23 /	23 /	18.0 /	23.0 /
Torque outputNm	125	125	205	120
Oil pressureidle [running] bar	1.8 [4.5 @ 4000]	1.8 [4.5 @ 4000]	2.0 [4.0 @ 4000]	[4.5 @ 4000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0.15 ± 0.08	0.15 ± 0.08	0: Hyd.	0.15 ± 0.08
- exhaust (mm).....	0.30 ± 0.08	0.30 ± 0.08	0: Hyd.	0.30 ± 0.08
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	FE	FE
Cooling system				
Thermostat opening temperature°C	83	83	83	89
Radiator cap pressurebar	1.4	1.4	1.4	1.4
Fuel system				
Idle speedrpm	875 ± 50	875 ± 50	800 ± 20	750 to 800
Maximum (no load) speedrpm	-	-	5000	5150
Smoke test/opacityM ⁻¹ %	2.01	1.77	2.0	2.5
Static timing method.....	-	-	-	Plunger travel
Timing dimension.....mm	Computer controlled	Computer controlled	Computer controlled	1.07 ± 0.02°
Crankshaft positionmm [°]	-	-	-	0 TDC
Turbo type / ref / pressure.....bar	-	-	KKK K03	-
Injection pump make.....	Lucas	Lucas	Bosch	Bosch
Injection pump part no.....	DWLP11	DWLP12	EDC15C2	VER 425/1
Injector Make / type.....	-	-	Bosch	-
Injector part no.....	Lucas RDN OSDC 6903	Lucas RDNOSDC 6903	-	DNOSD299A / RDNOSDC6887D
Injection type.....	-	-	Direct	Indirect
Injection opening pressure, New [used]...bar	135 ± 5	135 ± 5	200 to 1500	123 to 130
Glow plugs				
Maker.....	Beru/Champion	Beru/Champion	Champion	Bosch/Champion
Type.....	0100226371 / CH185	0100226371 / CH185	CH170	0250 201 019 / CH68
Nominal rating.....V/A	-	-	-	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	1.0	1.0	1.0	1.5
Tyres - Saloon / Hatch.....Size	175/70x13	175/65x14	175/65x14	185/65x14
- Estate / Van.....Size	-	-	-	-
Pressure - front / rear - Saloon / Hatch...bar	2.5 / 2.5	2.4 / 2.4	2.4 / 2.4	22.3 / 2.4
- Estate / Van.....bar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-0.75 ± 0.5	-0.75 ± 0.5	-0.75 ± 0.5	-2.0 ± 1.0 PAS: 2.0 ± 1.0
Camber.....	-0°0' ± 30'	-0°0' ± 30'	-0°0' ± 30'	-0°20' ± 30'
Castor.....	3° ± 30'	3° ± 30'	3° ± 30'	2°30' PAS: 3°30' ± 30'
King pin inclination.....	9°45' ± 30'	9°45' ± 30'	9°45' ± 30'	11°30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.7 ± 0.5	1.7 ± 0.5	1.7 ± 0.5	4.2 ± 1.5
Camber.....	1° ± 30'	1° ± 30'	1° ± 30'	-1°20' ± 15'



PEUGEOT

206 1.9 D
1998 to 2000

206 1.9 D
1999 to 2000

206 2.0 HDi
1999 to 2000

306 1.9 D
1993 to 1999

Torque wrench settings

Cylinder head - stage 1.....Nm	20 ²	20 ²	20 ¹	20 ²
- stage 2.....Nm	60	60	60	60
- stage 3.....Nm	+ 180° ± 5°	+ 180° ± 5°	+ 220°	+ 180°
- stage 4.....Nm	-	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	70	70	25 + 60°	70
Crankshaft pulley bolt.....Nm	40 + 60°	40 + 60°	197	40 + 60°
Camshaft pulley bolt.....Nm	45	45	43	45
Flywheel [driveplate] bolt.....Nm	48	48	48	50
Front hubs.....Nm	-	-	-	265 M24: 325
Rear hubs.....Nm	200	200	200	185
Wheel nuts / bolts.....Nm	85	85	85	85
Glow plugs.....Nm	22	22	10	25
Clutch pressure plate bolts.....Nm	20	20	20	22
Injection pump sprocket.....Nm	23	23	50	50
Injectors.....Nm	90	90	30	90
Injection pump mounting bolts.....Nm	20	20	22.5	-
Injector pipe unions.....Nm	25	25	20	-

Capacities

Engine oil & filter.....litres	4.75	4.75	4.5	5.0
Gearbox.....litres	2.0	2.0	2.0	2.15
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	-	WT	WT
Cooling system.....litres	8.2	8.2	6.25	9.0
Fuel tank.....litres	-	-	-	60

Notes

206 1.9 D 1998 to 2000

² Bolt length below head: ≤125.5 mm

206 1.9 D 1999 to 2000

²Bolt length below head: ≤125.5 mm Bolt without guide boss: ≤121.5 mm

206 2.0 HDi 1999 to 2000

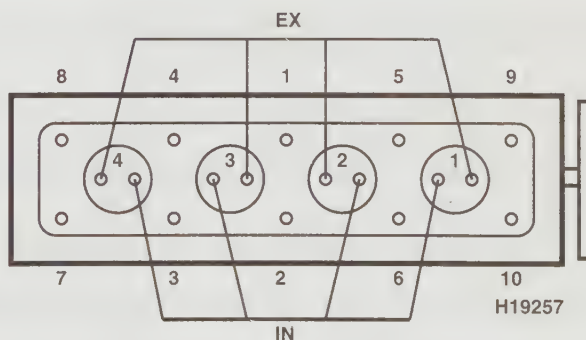
² Bolt length below head: ≤133.4 mm

306 1.9 D 1993 to 1999

¹or Lucas DPCR/C 8443B 980A

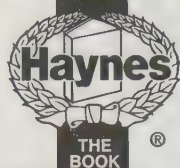
²Bolt length below head: ≤121.5 mm

³Lucas DPC: Dimension on pump



1868 cm³ / 1905 cm³ / 1996 cm³

- Not applicable, or information not available

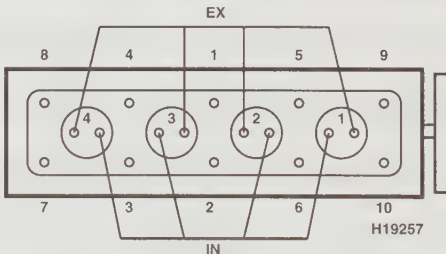
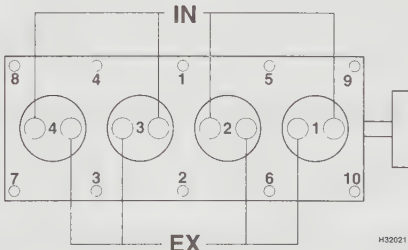


PEUGEOT

	306 1.9 TD 1993 to 1999	306 1.9 TD 1993 to 1999	306 1.9 D 1999 to 2000	306 2.0 HDi 1999 to 2000
Engine				
Engine type/code.....	XUD9TE/L D8A SOHC Turbo 68kW	XUD9TE/Y DHY SOHC Turbo 66kW	DW8/L3 WJZ SOHC 51kW	DW10TD/L3 RHY SOHC 66kW
Capacity (cm ³) / cylinders.....	1905 / 4	1905 / 4	1868 / 4	1996 / 4
Compression ratio / pressure.....bar	21.8 /	21.8 /	23.0 /	18.0 /
Torque outputNm	196	196	125	205
Oil pressureidle [running] bar	[4.9 @ 4000]	[4.9 @ 4000]	1.8 [4.5 @ 4000]	[3.8]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0.15 ± 0.08	0.15 ± 0.08	0.15 ± 0.07	0: Hyd.
- exhaust (mm).....	0.30 ± 0.08	0.30 ± 0.08	0.30 ± 0.07	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	89	89	89	83
Radiator cap pressure.....bar	1.4	1.4	1.4	1.4
Fuel system				
Idle speedrpm	750 to 800	750 to 800	875 ± 25	850 ± 25
Maximum (no load) speedrpm	5100	5100	5100	5100
Smoke test/opacityM ⁻¹ %	3.0	3.0	2.5	2.0
Static timing method.....	Plunger travel	Plunger travel	Refer to wsm	Refer to wsm
Timing dimension.....mm	0.66 ± 0.02	0.63 ± 0.02	-	-
Crankshaft position.....mm [°]	0 TDC	0 TDC	-	-
Turbo type / ref / pressure.....bar	KKK K14 / Garrett T2 ²	KKK K14 / Garrett T2 ²	-	Garrett T15 0.95 bar @ 2000
Injection pump make.....	Bosch	Bosch	Lucas	Bosch
Injection pump part no.....	VER 445	VER 472	DWLP11 ²	EDC15C2
Injector Make / type.....	Bosch	Bosch	-	-
Injector part no.....	DNOSD 299	DNOSD 299	DNOSD 299	DNOSD 299
Injection type.....	Indirect	Indirect	-	Direct common rail
Injection opening pressure, New [used]...bar	175 to 180	175 to 180	135 ± 5	200 to 1500
Glow plugs				
Maker.....	Bosch/Champion	Bosch/Champion	Beru/Champion	Bosch/Champion
Type.....	0250 201 033 / CH163	0250 201 033 / CH163	0100 226 6371 / CH185	0250 202 032 / CH170
Nominal rating.....V/A	11 / 12	11 / 12	-	-
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	-	-	-	-
Pressure - front / rear - Saloon / Hatch...bar	2.3 / 2.3	2.3 / 2.3	2.3 / 2.3	2.3 / 2.3
- Estate / Van.....bar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 ± 1.0	2.0 ± 1.0	2.0 ± 1.0	2.0 ± 1.0
Camber.....	-0°20' ± 30'	-0°20' ± 30'	-0°20' ± 30'	-0°20' ± 30'
Castor.....	3°20' ± 30'	3°20' ± 30'	3°20' ± 30'	3°20' ± 30'
King pin inclination.....	11°30'	11°30'	11°30'	11°30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	4.2 ± 1.5	4.2 ± 1.5	4.2 ± 1.5	4.2 ± 1.5
Camber.....	-1°20' ± 15'	-1°20' ± 15'	-1°20' ± 15'	-1°20' ± 15'



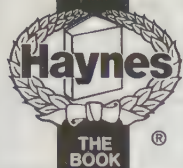
PEUGEOT

	306 1.9 TD 1993 to 1999	306 1.9 TD 1993 to 1999	306 1.9 D 1999 to 2000	306 2.0 HDi 1999 to 2000
Torque wrench settings				
Cylinder head - stage 1	Nm 20'	20'	20'	20'
- stage 2	Nm 60	60	60	60
- stage 3	Nm + 220°	+ 220°	+ 180°	+ 220°
- stage 4	Nm -	-	-	-
- stage 5	Nm -	-	-	-
- stage 6	Nm -	-	-	-
Big-end bearings	Nm 20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings	Nm 70	70	70	25 + 60°
Crankshaft pulley bolt	Nm 40 + 60°	40 + 60°	40 + 60°	197
Camshaft pulley bolt	Nm 45	45	45	43
Flywheel [driveplate] bolt	Nm 50	50	50	48
Front hubs	Nm 265 M24: 325	265 M24: 325	265 M24: 325	265 M24: 325
Rear hubs	Nm 185	185	185	185
Wheel nuts / bolts	Nm 85	85	85	85
Glow plugs	Nm 25	25	15	25
Clutch pressure plate bolts	Nm 22	22	22	22
Injection pump sprocket	Nm 50	50	23	50
Injectors	Nm 90	90	90	30
Injection pump mounting bolts	Nm -	-	20	22.5
Injector pipe unions	Nm -	-	25	20
Capacities				
Engine oil & filter	litres 5.0	5.0	5.0	5.0
Gearbox	litres 2.15	2.15	2.15	2.15
Automatic transmission	litres -	-	-	-
Final drive	litres WT	WT	WT	WT
Cooling system	litres 9.0	9.0	9.0	9.0
Fuel tank	litres 60	60	60	60
Notes				
<p>306 1.9 TD 1993 to 1999 ¹Bolt length below head: ≤146.5 mm ² 0.93 to 1.1 bar @ 3000rpm</p> <p>306 1.9 TD 1993 to 1999 ¹Bolt length below head: ≤146.5 mm ² 0.93 to 1.1 bar @ 3000rpm</p> <p>306 1.9 D 1999 to 2000 ¹Bolt length below head: ≤121.5 mm Bolt with guide boss: ≤125.5 mm ² or Bosch DWBP11</p> <p>306 2.0 HDi 1999 to 2000 ¹Max bolt length below head: ≤133.3 mm</p>				
 <p>1905 cm³</p>  <p>1868 cm³ / 1996 cm³</p>				
<p>- Not applicable, or information not available</p>				



PEUGEOT

	309 1.7 1987 to 1993	309 1.7 1987 to 1993	309 1.7 Turbo 1989 to 1993	309 1.9 1986 to 1993
Engine				
Engine type/code.....	XUD7 A9A SOHC 44kW	XUD7 A9A SOHC 44kW	XUD7T/L A8B SOHC Turbo 58kW	XUD9 D9A SOHC 47kW
Capacity (cm ³) / cylinders.....	1769 / 4	1769 / 4	1769 / 4	1905 / 4
Compression ratio / pressure.....bar	23.0 / _	23.0 / _	22.0 / _	23.5 / _
Torque output.....Nm	108	108	157	120
Oil pressure.....idle [running] bar	2.0 [4.5 @ 4000]	2.0 [4.5 @ 4000]	2.0 [4.5 @ 4000]	2.0 [4.5 @ 4000]
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0.15 ± 0.04	0.15 ± 0.04	0.15 ± 0.04	0.15 ± 0.04
- exhaust (mm).....	0.30 ± 0.04	0.30 ± 0.04	0.30 ± 0.04	0.30 ± 0.04
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature.....°C	82	82	82	83
Radiator cap pressure.....bar	1.0	1.0	1.0	1.0
Fuel system				
Idle speed.....rpm	800 ± 50	800 ± 50	775 ± 25	800 ± 50
Maximum (no load) speed.....rpm	5100	5100	4800	5100
Smoke test/opacity.....M ⁻¹ %	3.0	3.0	3.0	2.5
Static timing method.....	Plunger travel	Refer to wsm	Dial gauge	Dial gauge
Timing dimension.....mm	0.30	-	Dimension on pump	0.01
Crankshaft position.....mm [°]	0.80 ± 0.03	-	TDC	2.26 ± 0.05
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	Bosch	Roto Diesel	Roto Diesel	Roto Diesel
Injection pump part no.....	2300 R171 R523	R8443262D	R8443 B260A/052 or 261C	R8443 261A
Injector Make / type.....	Bosch	Roto Diesel	Roto Diesel	Roto Diesel
Injector part no.....	DNOSD 256	RDNOSDC6850	RDNOSDC 682D	RDNOSDC 6850B
Injection type.....	Indirect VE4/8F	Indirect DPC	Indirect DPC	Indirect DPC
Injection opening pressure, New [used]...bar	130 ± 5	115 [103]	115 ± 5	115 ± 5
Glow plugs				
Maker.....	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type.....	0250 201 033 / CH68	0250 201 033 / CH68	0250 201 019 / CH68	0250 201 019 / CH68
Nominal rating.....V/A	11 / 12	11 / 12	11 / 12	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	1.0	1.0	1.0	1.0
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	165/70x13	165/70x13	175/65x14	165/70x13
Pressure - front / rear - Saloon / Hatch...bar	1.9 / 2.1	1.9 / 2.1	1.9 / 2.1	1.9 / 2.1
- Estate / Van.....bar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.5 ± 0.5 PW	0.5 ± 0.5 PW	0.5 ± 0.5 PW	0.5 ± 0.5 PW
Camber.....	-30' ± 30'	-30' ± 30'	-30' ± 30'	-30' ± 30'
Castor.....	2° ± 30'	2° ± 30'	2°10' ± 30'	2° ± 30'
King pin inclination.....	10°15' ± 30'	10°15' ± 30'	10°15' ± 30'	10°15' ± 30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.6 ± 0.8 PW'	1.6 ± 0.8 PW'	1.9 ± 0.8 PW	1.6 ± 0.8 PW'
Camber.....	-50' ± 30'	-50' ± 30'	-1°20' ± 30'	-50' ± 30'



PEUGEOT

	309 1.7 1987 to 1993	309 1.7 1987 to 1993	309 1.7 Turbo 1989 to 1993	309 1.9 1986 to 1993
Torque wrench settings				
Cylinder head - stage 1.....Nm	30 N	30 N	30 N	30 N
- stage 2.....Nm	70	70	70	70
- stage 3.....Nm	+ 120°	+ 120°	+ 120°	+ 120°
- stage 4.....Nm	-	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	70	70	70	70
Crankshaft pulley bolt.....Nm	40 + 60°	40 + 60°	40 + 60°	40 + 60°
Camshaft pulley bolt.....Nm	40	40	40	40
Flywheel [driveplate] bolt.....Nm	50 LkC	50 LkC	50 LkC	50 LkC
Front hubs.....Nm	265	265	265	265
Rear hubs.....Nm	215	215	215	215
Wheel nuts / bolts.....Nm	85	85	85	85
Glow plugs.....Nm	22	22	22	22
Clutch pressure plate bolts.....Nm	25	25	25	25
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	90	90	90	90
Injection pump mounting bolts.....Nm	-	-	-	-
Injector pipe unions.....Nm	-	-	-	-
Capacities				
Engine oil & filter.....litres	4.8	4.8	4.8	4.8
Gearbox.....litres	2.0	2.0	2.0	2.0
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	8.5	8.5	8.5	8.5
Fuel tank.....litres	55	55	55	55

Notes

309 1.7 1987 to 1993

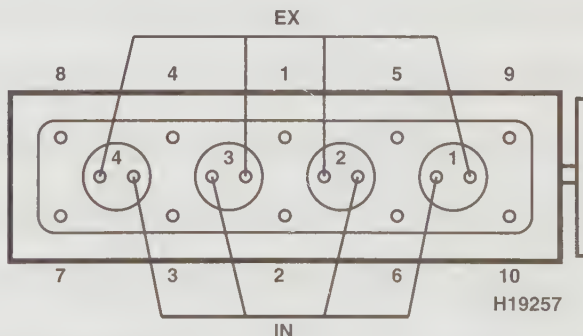
'1990 ▶: 1.8±0.8 PW

309 1.7 1987 to 1993

'1990 ▶: 1.8±0.8 PW

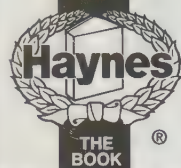
309 1.9 1986 to 1993

'1990 ▶: 1.8±0.8 PW



1769 cm³ / 1905 cm³

- Not applicable, or information not available



PEUGEOT

	309 1.9 1987 to 1993	309 1.9 EGR 1987 to 1993	405 1.7 Turbo 1988 to 1992	405 1.7 Turbo 1988 to 1992
Engine				
Engine type/code.....	XUD9 D9A SOHC 47kW	XUD9Y DJZ SOHC 47kW	XUD7TE A8A SOHC Turbo 66kW	XUD7TE A8A SOHC Turbo 66kW
Capacity (cm ³) / cylinders.....	1905 / 4	1905 / 4	1769 / 4	1769 / 4
Compression ratio / pressure.....bar	23.5 / _	23.5 / _	22.0 / _	22.0 / _
Torque output.....Nm	120	120	157	157
Oil pressure.....idle [running] bar	2.0 [4.5 @ 4000]	2.0 [4.5 @ 4000]	2.0 [4.5 @ 4000]	2.0 [4.5 @ 4000]
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0.15 ± 0.04	0.15 ± 0.04	0.15 ± 0.04	0.15 ± 0.04
- exhaust (mm).....	0.30 ± 0.04	0.30 ± 0.04	0.30 ± 0.04	0.30 ± 0.04
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature.....°C	83	83	88	88
Radiator cap pressure.....bar	1.0	1.0	1.0	1.0
Fuel system				
Idle speed.....rpm	800 ± 50	775 ± 50	750 to 800	750 to 800
Maximum (no load) speed.....rpm	5100	5100	4800	4800
Smoke test/opacity.....M ⁻¹ %	2.5	2.5	3.0	3.0
Static timing method.....	Plunger travel	Plunger travel	Dial gauge	Plunger travel
Timing dimension.....mm	0.3	1.0	Dimension on pump	0.8
Crankshaft position.....mm [°]	0.50 ± 0.03	0.77 ± 0.03	TDC	1.0 ± 0.03
Turbo type / ref / pressure.....bar	_	_	0.85 bar @ 3000rpm	0.85 bar @ 3000rpm
Injection pump make.....	Bosch	Bosch	Roto Diesel	Bosch
Injection pump part no.....	2300 R162	VE4/9 R162.4	R8443 B452C	2150 R316
Injector Make / type.....	Bosch	Bosch	Roto Diesel	Bosch
Injector part no.....	0432 217 153	0432 217 153	RDNOSDC 6862C	DNQSD 289
Injection type.....	Indirect VE4/9F	Indirect VE4/9F	Indirect DPC	Indirect VE4/8F
Injection opening pressure, New [used]...bar	130 ± 5 [117]	130 ± 5	130 ± 5	130 ± 5
Glow plugs				
Maker.....	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type.....	0250 201 019 / CH68	0250 201 019 / CH68	0250 201 019 / CH68	0250 201 019 / CH68
Nominal rating.....V/A	11 / 12	11 / 12	11 / 12	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	1.0	1.0	1.0	1.0
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size	165/70x13	165/70x13	185/65x14	185/65x14
- Estate / Van.....Size	_	_	185/65x14	185/65x14
Pressure - front / rear - Saloon / Hatch...bar	1.9 / 2.1	1.9 / 2.1	2.1 / 2.1	2.1 / 2.1
- Estate / Van...bar	_	_	2.1 / 2.4	2.1 / 2.4
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.5 ± 0.5 PW	0.5 ± 0.5 PW	1.0 ± 0.5 PW	1.0 ± 0.5 PW
Camber.....	-30' ± 30'	-30' ± 30'	0° ± 30'	0° ± 30'
Castor.....	2° ± 30'	2° ± 30'	3°10' ± 30''	3°10' ± 30''
King pin inclination.....	10°15' ± 30'	10°15' ± 30'	11°25' ± 30'	11°25' ± 30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.6 ± 0.8 PW ¹	1.6 ± 0.8 PW ¹	-2.5 ± 0.8 PW ²	-2.5 ± 0.8 PW ²
Camber.....	-50' ± 30'	-50' ± 30'	-1°20' ± 30'	-1°20' ± 30'



PEUGEOT

	309 1.9 1987 to 1993	309 1.9 EGR 1987 to 1993	405 1.7 Turbo 1988 to 1992	405 1.7 Turbo 1988 to 1992
Torque wrench settings				
Cylinder head - stage 1.....Nm	30 N	30 N	30 N	30 N
- stage 2.....Nm	70	70	70	70
- stage 3.....Nm	+ 120°	+ 120°	+ 120°	+ 120°
- stage 4.....Nm	-	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	70	70	70	70
Crankshaft pulley bolt.....Nm	40 + 60°	40 + 60°	40 + 60°	40 + 60°
Camshaft pulley bolt.....Nm	40	40	40	40
Flywheel [driveplate] bolt.....Nm	50 LkC	50 LkC	50 LkC	50 LkC
Front hubs.....Nm	265	265	265	265
Rear hubs.....Nm	215	215	275	275
Wheel nuts / bolts.....Nm	85	85	85	85
Glow plugs.....Nm	22	22	22	22
Clutch pressure plate bolts.....Nm	25	25	25	25
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	90	90	90	90
Injection pump mounting bolts.....Nm	-	-	-	-
Injector pipe unions.....Nm	-	-	-	-
Capacities				
Engine oil & filter.....litres	4.8	4.8	4.75	4.75
Gearbox.....litres	2.0	2.0	2.0	2.0
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	8.5	8.5	7.8	7.8
Fuel tank.....litres	55	55	70	70

Notes

309 1.9 1987 to 1993

*1990 ►: 1.8±0.8 PW

309 1.9 EGR 1987 to 1993

*1990 ►: 1.8 ± 0.8 PW

405 1.7 Turbo 1988 to 1992

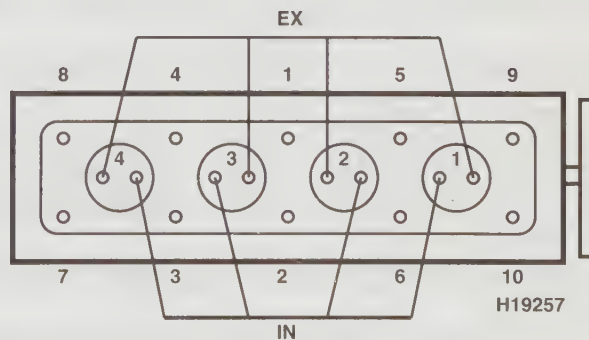
*Estate: 1°40'±30' [PAS: 2°25'±30']

*Estate: -1.4±0.8 PW

405 1.7 Turbo 1988 to 1992

*Estate: 1°40'±30' [PAS: 2°25'±30']

*Estate: -1.4±0.8 PW



1769 cm³ / 1905 cm³



PEUGEOT

	405 1.7 Turbo 1992 to 1994	405 1.9 1988 to 1991	405 1.9 1988 to 1991	405 1.9 EGR 1988 to 1991
Engine				
Engine type/code.....	XUD7TE/Y AJZ SOHC Turbo 66kW	XUD9A D9B SOHC 51kW	XUD9A D9B SOHC 51kW	XUD9Y DJZ SOHC 47kW
Capacity (cm ³) / cylinders.....	1769 / 4	1905 / 4	1905 / 4	1905 / 4
Compression ration / pressurebar	22.0 / _	23.0 / _	23.0 / _	23.5 / _
Torque outputNm	157	120	120	118
Oil pressureidle [running] bar	2.0 [4.5 @ 4000]	2.0 [4.5 @ 4000]	2.0 [4.5 @ 4000]	2.0 [4.5 @ 4000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.15 ± 0.04	0.15 ± 0.04	0.15 ± 0.04	0.15 ± 0.04
- exhaust (mm)	0.30 ± 0.04	0.30 ± 0.04	0.30 ± 0.04	0.30 ± 0.04
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	88	88	88	88
Radiator cap pressurebar	1.0	1.0	1.0	1.0
Fuel system				
Idle speedrpm	750 to 800	750 to 800	750 to 800	775 ± 50
Maximum (no load) speedrpm	4800	5150	5150	5100
Smoke test/opacityM ⁻¹ %	3.0	2.5	2.5	2.5
Static timing method.....	Plunger travel	Plunger travel	Dial gauge	Plunger travel
Timing dimension.....mm	0.74	0.9	Dimension on pump	0.77
Crankshaft positionmm [°]	0 TDC	0 TDC	TDC	0 TDC
Turbo type / ref / pressurebar	0.85 bar @ 3000rpm	-	-	-
Injection pump make	Bosch	Bosch	Roto Diesel	Bosch
Injection pump part no.....	R403	2300 R272/2	R8443 B380A, 381B	2300 R162.4
Injector Make / type.....	Bosch	Bosch	Roto Diesel	Bosch
Injector part no.....	-	DNOSD 287+	RDNOSDC 6751C	DNOSD 256
Injection type.....	Indirect VE4/8F	Indirect VF4/9F	Indirect DPC	Indirect VE4/9F
Injection opening pressure, New [used]...bar	150 ± 5	130 ± 5	125 ± 5	130 ± 5
Glow plugs				
Maker	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type	0250 201 019 / CH68	0250 201 019 / CH68	0250 201 019 / CH68	0250 201 019 / CH68
Nominal rating.....V/A	11 / 12	11 / 12	11 / 12	11 / 13
Brakes				
minimum friction material thickness				
Front.....mm	1.0	1.0	1.0	1.0
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185/65x14	165/70x14: 175/70x14	165/70x14: 175/70x14	165/70x14: 175/70x14
Pressure - front / rear - Saloon / Hatch...bar	2.1 / 2.1	2.1 / 2.1	2.1 / 2.1	2.1 / 2.1
- Estate / Vanbar	2.1 / 2.4	2.1 / 2.3	2.1 / 2.3	2.1 / 2.3
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 ± 0.5 PW	1.0 ± 0.5 PW	1.0 ± 0.5 PW	1.0 ± 0.5 PW
Camber	0° ± 30'	0° ± 30'	0° ± 30'	0° ± 30'
Castor	3°10' ± 30''	3°10' ± 30''	3°10' ± 30''	3°10' ± 30''
King pin inclination.....	11°25' ± 30'	11°25' ± 30'	11°25' ± 30'	11°25' ± 30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-2.5 ± 0.8 PW ²	-2.5 ± 0.8 PW ²	-2.5 ± 0.8 PW ²	-2.5 ± 0.8 PW ²
Camber	-1°20' ± 30'	-1°20' ± 30'	-1°20' ± 30'	-1°20' ± 30'



PEUGEOT

	405 1.7 Turbo 1992 to 1994	405 1.9 1988 to 1991	405 1.9 1988 to 1991	405 1.9 EGR 1988 to 1991
Torque wrench settings				
Cylinder head - stage 1.....Nm	30 N	30 N	30 N	30 N
- stage 2.....Nm	70	70	70	70
- stage 3.....Nm	+ 120°	+ 120°	+ 120°	+ 120°
- stage 4.....Nm	-	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	70	70	70	70
Crankshaft pulley bolt.....Nm	40 + 60°	40 + 60°	40 + 60°	40 + 60°
Camshaft pulley bolt.....Nm	40	40	40	40
Flywheel [driveplate] bolt.....Nm	50 LkC	50 LkC	50 LkC	50 LkC
Front hubs.....Nm	265	265	265	265
Rear hubs.....Nm	275	275	275	275
Wheel nuts / bolts.....Nm	85	85	85	85
Glow plugs.....Nm	22	22	22	22
Clutch pressure plate bolts.....Nm	25	25	25	25
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	90	90	90	90
Injection pump mounting bolts.....Nm	-	-	-	-
Injector pipe unions.....Nm	-	-	-	-
Capacities				
Engine oil & filter.....litres	4.75	4.5	4.5	4.75
Gearbox.....litres	2.0	2.0	2.0	2.0
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	7.8	7.8	7.8	7.8
Fuel tank.....litres	70	70	70	70

Notes

405 1.7 Turbo 1992 to 1994

¹Estate: 1°40'±30' [PAS: 2°25'±30']

²Estate: -1.4±0.8 PW

405 1.9 1988 to 1991

¹Estate: 1°40'±30' [PAS: 2°25'±30']

²Estate: -1.4±0.8 PW

405 1.9 1988 to 1991

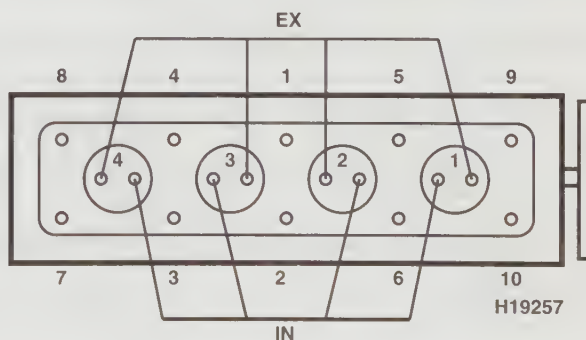
¹Estate: 1°40'±30' [PAS: 2°25'±30']

²Estate: -1.4±0.8 PW

405 1.9 EGR 1988 to 1991

¹Estate: 1°40'±30' [PAS: 2°25'±30']

²Estate: -1.4±0.8 PW



1769 cm³ / 1905 cm³

- Not applicable, or information not available



PEUGEOT

	405 1.9 D 1992 to 1996	405 1.9 D 1992 to 1996	405 1.9 D 1992 to 1996	405 1.9 TD 1992 to 1996
Engine				
Engine type/code.....	XUD9A/L D9B SOHC 51kW	XUD9A/L D9B SOHC 51kW	XUD9A/Y DJZ SOHC 47kW	XUD9TE/Y DHY SOHC Turbo 66kW
Capacity (cm ³) / cylinders.....	1905 / 4	1905 / 4	1905 / 4	1905 / 4
Compression ratio / pressurebar	23.0 /	23.0 /	23.0 /	21.8 /
Torque outputNm	120	120	118	196
Oil pressureidle [running] bar	[4.5 @ 4000]	[4.5 @ 4000]	[4.5 @ 4000]	[4.5 @ 4000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0.15 ± 0.04	0.15 ± 0.04	0.15 ± 0.04	0.15 ± 0.04
- exhaust (mm).....	0.30 ± 0.04	0.30 ± 0.04	0.30 ± 0.04	0.30 ± 0.04
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	83	83	83	83
Radiator cap pressurebar	1.0	1.0	1.0	1.4
Fuel system				
Idle speedrpm	750 to 800	750 to 800	750 to 800	750 to 800
Maximum (no load) speedrpm	5150	5150	5150	5100
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	3.0
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Dial gauge
Timing dimension.....mm	1.07 ± 0.02	Dimension on pump	0.77	0.66
Crankshaft positionmm [°]	0 TDC	0 TDC	0 TDC	0 TDC
Turbo type / ref / pressurebar	-	-	-	Garrett T2 / KKK K14 ²
Injection pump make.....	Bosch	Roto Diesel	Bosch	Bosch
Injection pump part no.....	VER425/1	R8443B980A	VER 162	VER 472
Injector Make / type.....	Bosch	Roto Diesel	Bosch	Bosch
Injector part no.....	DNOSD299A	RDNOSDC6887D	256	299
Injection type.....	Indirect VER	Indirect DPC	Indirect VER	Indirect VER
Injection opening pressure, New [used]...bar	130	-	130	175
Glow plugs				
Maker.....	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type.....	0250 201 019 / CH68	0250 201 019 / CH68	0250 201 019 / CH68	0250 201 033 / CH68
Nominal rating.....V/A	11 / 13	11 / 13	11 / 13	11 / 13
Brakes				
minimum friction material thickness				
Front.....mm	1.0	1.0	1.0	1.0
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175/70x14	175/70x14	175/70x14	185/65x14
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.2	2.2 / 2.2	2.2 / 2.2	2.2 / 2.2
- Estate / Vanbar	2.4 / 2.4	2.4 / 2.4	2.4 / 2.4	2.3 / 2.3
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 ± 1.0	2.0 ± 1.0	2.0 ± 1.0	2.1 ± 1.0
Camber.....	0° ± 30'	0° ± 30'	0° ± 30'	0° ± 30'
Castor.....	2°10' ± 30' PAS: 3° ± 30'	2°10' ± 30' PAS: 3° ± 30'	2°10' ± 30' PAS: 3° ± 30'	3° ± 30'
King pin inclination.....	11°30' ± 30'	11°30' ± 30'	11°30' ± 30'	11°30' ± 30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	5.4 ± 1.4 Est: 2.1 ± 1.4	5.4 ± 1.4 Est: 2.1 ± 1.4	5.4 ± 1.4 Est: 2.1 ± 1.4	5.4 ± 1.4 Est: 2.1 ± 1.4
Camber.....	-1°30' ± 30'	-1°30' ± 30'	-1°30' ± 30'	-



PEUGEOT

405 1.9 D
1992 to 1996

405 1.9 D
1992 to 1996

405 1.9 D
1992 to 1996

405 1.9 TD
1992 to 1996

Torque wrench settings

Cylinder head - stage 1	Nm	20'	20'	20'	20'
- stage 2	Nm	60	60	60	60
- stage 3	Nm	+ 180°	+ 180°	+ 180°	+ 220°
- stage 4	Nm	-	-	-	-
- stage 5	Nm	-	-	-	-
- stage 6	Nm	-	-	-	-
Big-end bearings	Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings	Nm	70	70	70	15 + 60°
Crankshaft pulley bolt	Nm	40 + 60°	40 + 60°	40 + 60°	40 + 60°
Camshaft pulley bolt	Nm	45	45	45	45
Flywheel [driveplate] bolt	Nm	50	50	50	50
Front hubs	Nm	320	320	320	320
Rear hubs	Nm	275	275	275	275
Wheel nuts / bolts	Nm	85	85	85	85
Glow plugs	Nm	25	25	25	25
Clutch pressure plate bolts	Nm	25	25	25	25
Injection pump sprocket	Nm	50	50	50	50
Injectors	Nm	90	90	90	90
Injection pump mounting bolts	Nm	-	-	-	-
Injector pipe unions	Nm	-	-	-	-

Capacities

Engine oil & filter	litres	5.0	5.0	5.0	5.0
Gearbox	litres	2.0	2.0	2.0	2.0
Automatic transmission	litres	-	-	-	-
Final drive	litres	WT	WT	WT	WT
Cooling system	litres	7.8	7.8	7.8	7.0
Fuel tank	litres	70	70	70	70

Notes

405 1.9 D 1992 to 1996

*Bolt length below head: ≤121.5 mm

405 1.9 D 1992 to 1996

*Bolt length below head: ≤121.5 mm

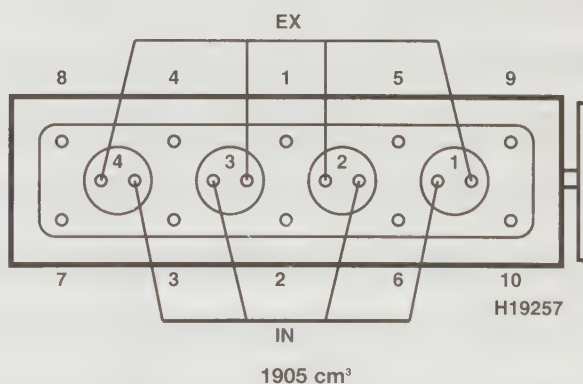
405 1.9 D 1992 to 1996

*Bolt length below head: ≤121.5 mm

405 1.9 TD 1992 to 1996

*Bolt length below head: ≤146.5 mm

*0.85 bar @ 3000rpm



- Not applicable, or information not available



PEUGEOT

	405 1.9 TD 1992 to 1996	406 1.9 TD 1996 to 1999	406 1.9 TD 1996 to 1999	406 2.0 HDi 1999 to 2000
Engine				
Engine type/code.....	XUD9TE/L D8A SOHC Turbo 68kW	XUD9TE/L D8A SOHC Turbo 66kW	XUD9BTF DHX SOHC Turbo 66kW	DW10TD/L3 RHY SOHC 66kW
Capacity (cm ³) / cylinders.....	1905 / 4	1905 / 4	1905 / 4	1997 / 4
Compression ratio / pressure.....bar	21.8 /	21.8 /	21.8 /	18.0 / ≥30.0
Torque outputNm	196	196	196	205
Oil pressureidle [running] bar	[4.5 @ 4000]	[4.5 @ 4000]	[4.5 @ 4000]	[3.8]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0.15 ± 0.04	0.15 ± 0.04	0.15 ± 0.04	0: Hyd.
- exhaust (mm).....	0.30 ± 0.04	0.30 ± 0.04	0.30 ± 0.04	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	83	83	83	83
Radiator cap pressure.....bar	1.4	1.4	1.4	1.4
Fuel system				
Idle speedrpm	750 to 800	750 to 800	800 ± 50	850 ± 50
Maximum (no load) speedrpm	5100	5100	5100	5100
Smoke test/opacityM ⁻¹ %	2.5	1.84	2.41	2.5
Static timing method.....	Dial gauge	Refer to wsm	Dial gauge	Refer to wsm
Timing dimension.....mm	0.66	-	0.57	-
Crankshaft positionmm [°]	0 TDC	-	0 TDC	-
Turbo type / ref / pressure.....bar	Garrett T2 / KKK K14 ²	Garrett T2 / KKK K14 ²	Garrett T2 / KKK K14 ²	KKK or Garrett
Injection pump make.....	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VER 445	VER 445	VP20	EDC15C2
Injector Make / type.....	Bosch	Bosch	Bosch	-
Injector part no.....	299	DNOSD299	DNOSD299C	-
Injection type.....	Indirect VER	Indirect	Indirect	Direct
Injection opening pressure, New [used]...bar	175	175	175	200 to 1500
Glow plugs				
Maker.....	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type.....	0250 201 033 / CH68	0250 201 033 / CH68	0250 201 033 / CH68	0250 202 032 / CH170
Nominal rating.....V/A	11 / 13	11 / 12	11 / 12	-
Brakes				
minimum friction material thickness				
Front.....mm	1.0	2.0	2.0	2.0
Rear.....mm	1.5	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185/65x14	195/65x15	195/65x15	185/70x14: 195/65x15:205/60x15
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.2	2.2 / 2.2	2.2 / 2.2	2.4 / 2.4: 2.3 / 2.3:2.4 / 2.4
- Estate / Van.....bar	2.3 / 2.3	-	-	2.4 / 2.5: 2.4 / 2.4:2.4 / 2.4
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.1 ± 1.0	0.0 ± 0.5	0.0 ± 0.5	0.0 ± 0.5
Camber.....	0° ± 30'	0°30'	0°30'	0° ± 30'
Castor.....	3° ± 30'	3°30' ± 30'	3°30' ± 30'	3°30' ± 30'
King pin inclination.....	11°30' ± 30'	11°30' ± 30'	11°30' ± 30'	11°30' ± 30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	5.4 ± 1.4 Est: 2.1 ± 1.4	1.5 ± 0.5	1.5 ± 0.5	1.5 ± 0.5
Camber.....	-	-1°50' ± 30'	-1°50' ± 30'	1°50' ± 30'



PEUGEOT

	405 1.9 TD 1992 to 1996	406 1.9 TD 1996 to 1999	406 1.9 TD 1996 to 1999	406 2.0 HDi 1999 to 2000
Torque wrench settings				
Cylinder head - stage 1Nm	20 ¹	20 ¹	20 ¹	20 ¹
- stage 2Nm	60	60	60	60
- stage 3Nm	+ 220°	+ 220°	+ 220°	+ 220°
- stage 4Nm	-	-	-	-
- stage 5Nm	-	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	15 + 60°	15 + 60°	15 + 60°	25 + 60°
Crankshaft pulley boltNm	40 + 60°	40 + 50°	40 + 50°	197
Camshaft pulley boltNm	45	45	45	43
Flywheel [driveplate] bolt.....Nm	50	50	50	48
Front hubsNm	320	320	320	325
Rear hubsNm	275	270	270	275
Wheel nuts / boltsNm	85	85	85	90
Glow plugsNm	25	25	25	25
Clutch pressure plate boltsNm	25	20	20	20
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	90	90	90	30
Injection pump mounting boltsNm	-	20	20	22.5
Injector pipe unions.....Nm	-	20	20	20
Capacities				
Engine oil & filter.....litres	5.0	4.2	4.2	4.5
Gearbox.....litres	2.0	2.0	2.0	2.0
Automatic transmissionlitres	-	-	-	-
Final drivelitres	WT	WT	WT	WT
Cooling system.....litres	7.0	7.0	7.0	7.0
Fuel tank.....litres	70	70	70	70

Notes

405 1.9 TD 1992 to 1996

¹Bolt length below head: ≤146.5 mm

²0.85 bar @ 3000rpm

406 1.9 TD 1996 to 1999

¹Bolt length below head: ≤146.5 mm

²0.93 to 1.07 bar @ 3000rpm

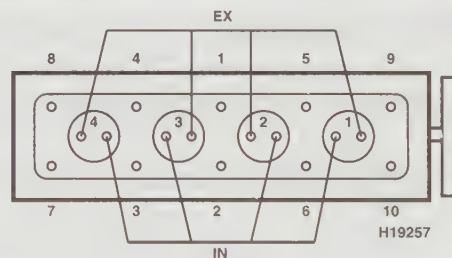
406 1.9 TD 1996 to 1999

¹Bolt length below head: ≤146.5 mm

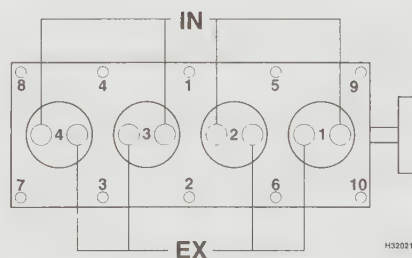
²0.93 to 1.07 bar @ 3000rpm

406 2.0 HDi 1999 to 2000

¹Max bolt length below head ≤133.3 mm



1905 cm³



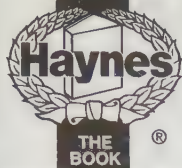
1997 cm³

- Not applicable, or information not available



PEUGEOT

	406 2.0 HDi 1999 to 2000	406 2.1TD 1996 to 1999	504 2.3 Pick-up 1982 to 1993	505 2.5 1982 to 1992
Engine				
Engine type/code.....	DW10ATED/L3 RHZ SOHC 80kW	XUD11BTE/L P8C Turbo 81kW	XD2 134 OHV 51kW	XD3 155 OHV 51kW
Capacity (cm ³) / cylinders.....	1997 / 4	2088 / 4	2304 / 4	2498 / 4
Compression ratio / pressure.....bar	17.6 / ≥30.0	21.5 / ≥18.0	22.2 / ≥18.0	23.0 / _
Torque outputNm	250	250	0	0
Oil pressureidle [running] bar	[3.8]	[2.5 @ 2000]	1.5 [3.0 @ 4000]	1.5
Oil temperature°C	80	80	90	90
Valve clearances - inlet (mm).....	0: Hyd.	0: Hyd.	0.15	0.15
- exhaust (mm).....	0: Hyd.	0: Hyd.	0.25	0.25
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	83	83	78	81
Radiator cap pressurebar	1.4	1.4	0.8 5.89 ▶: 1.0	0.8
Fuel system				
Idle speedrpm	850 ± 50	675 ± 25	750 to 800	700 to 800 [800 to 850]
Maximum (no load) speedrpm	5100	5150	4750	4850
Smoke test/opacityM ⁻¹ %	2.41	2.41	2.5	2.5
Static timing method.....	Refer to wsm	Refer to wsm	Dial gauge	Dial gauge
Timing dimension.....mm	-	0.88	0.01	0.01'
Crankshaft positionmm [°]	-	0 TDC	3.83 ± 0.05 [22]	2.85 ± 0.05 [18]'
Turbo type / ref / pressure.....bar	KKK	Mitsubishi TD04 1.0 bar @ 3000	-	-
Injection pump make.....	Bosch	Lucas	Roto Diesel	Roto Diesel
Injection pump part no.....	EDC15C2	EPIC	R3443 F790 040 or 794/5	100A, 150A, 152A, A155B, B156B
Injector Make / type.....	-	Bosch	Roto Diesel	Roto Diesel
Injector part no.....	-	DNOSD 299	RDNOSDC 6577 or 6577B	RDNOSDC 6577 or RDN12SCC 6849
Injection type.....	Direct	Indirect	DPA	DPC R8443
Injection opening pressure, New [used]...bar	200 to 1500	163 ± 3.5	115 ± 5	115 ± 5
Glow plugs				
Maker.....	Bosch/Champion	Bosch/Champion	Bosch/Beru	Bosch/Champion
Type.....	0250 202 032 / CH170	0250 201 019 / CH68	0250 200 019 / 0 100 221 118	0250 201 019 / CH68
Nominal rating.....V/A	-	11 / 12	11 / 8.5	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	1.0	1.0
Rear.....mm	1.0	2.0	1.5	1.5
Tyres - Saloon / Hatch.....Size	185/70x14: 195/65x15:205/60x15	195/65x15	-	175x14
- Estate / Van.....Size	185/70x14: 195/65x15:205/60x15	-	185x15	185x14
Pressure - front / rear - Saloon / Hatch...bar	2.4 / 2.4: 2.3 / 2.3:2.4 / 2.4	2.2 / 2.2	-	1.8 / 2.1
- Estate / Van.....bar	2.4 / 2.5: 2.4 / 2.4:2.4 / 2.4	-	1.6 / 4.0'	1.9 / 2.2
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.0 ± 0.5	0.0 ± 0.5	2.2 ± 1.0	3.0 ± 1.0°
Camber.....	0° ± 30'	0°30'	45' ± 30'	-45' ± 30' Est: -30'±30'
Castor.....	3°30' ± 30'	3°30' ± 30'	1°30' ± 45'	2°40' ± 30' Est: 2°±30'
King pin inclination.....	11°30' ± 30'	11°30' ± 30'	8°54' ± 30'	9°15' ± 30' Est: 9°±30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.5 ± 0.5	1.5 ± 0.5	0	3.0 ± 1.0 Est: 0
Camber.....	1°50' ± 30'	-1°50' ± 30'	0	-1° ± 30' Est: 0



PEUGEOT

	406 2.0 HDi 1999 to 2000	406 2.1TD 1996 to 1999	504 2.3 Pick-up 1982 to 1993	505 2.5 1982 to 1992
Torque wrench settings				
Cylinder head - stage 1.....Nm	20 ¹	20 ¹	30	30
- stage 2.....Nm	60	60	50	70
- stage 3.....Nm	+ 220°	+ 180°	Slacken, 70	Slacken, 70
- stage 4.....Nm	-	-	Warm up, allow to cool	Warm up, allow to cool
- stage 5.....Nm	-	-	Slacken, 70	Slacken, 70
- stage 6.....Nm	-	-	+ 120°	+ 120°
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	60 N	60 N
Main bearings.....Nm	25 + 60°	15 + 60°	110	120
Crankshaft pulley bolt.....Nm	197	50	55 + 60°	55 + 60°
Camshaft pulley bolt.....Nm	43	20	-	-
Flywheel [driveplate] bolt.....Nm	48	50	50	15 + 60°
Front hubs.....Nm	325	320	WSM	WSM
Rear hubs.....Nm	275	275	250	280
Wheel nuts / bolts.....Nm	90	85	60	Steel: 60 Alloy: 85
Glow plugs.....Nm	25	25	23	23
Clutch pressure plate bolts.....Nm	-	20	15	20
Injection pump sprocket.....Nm	50	50	-	-
Injectors.....Nm	30	90	90	90
Injection pump mounting bolts.....Nm	22.5	20	20	20
Injector pipe unions.....Nm	20	20	30	30
Capacities				
Engine oil & filter.....litres	4.5	4.0	5.0	5.0
Gearbox.....litres	2.0	1.85	1.15	BA7: 1.8 BA10: 1.85
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	1.6	1.6
Cooling system.....litres	7.0	7.0	10.0	10.0
Fuel tank.....litres	70	70	64	70

Notes

406 2.0 HDi 1999 to 2000

¹Max bolt length below head ≤133.3 mm

406 2.1TD 1996 to 1999

¹Max bolt length: Refer to dealer for latest spec.

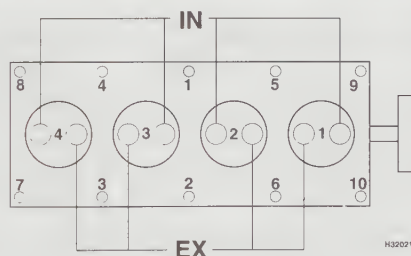
504 2.3 Pick-up 1982 to 1993

¹Varies according to tyre manufacturer

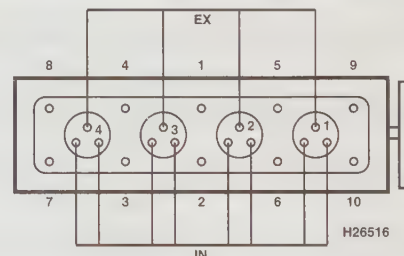
505 2.5 1982 to 1992

¹R8443 B156B: value marked on pump

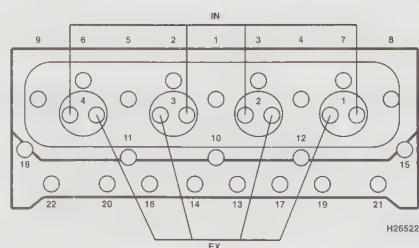
²Estate: 3.5±1.0



1997 cm³



2088 cm³



2304 cm³ / 2498 cm³

- Not applicable, or information not available



PEUGEOT

	505 2.5 1982 to 1992	605 2.1 TD 1990 to 1998	605 2.1 TD 1990 to 1993	605 2.1 TD 1993 to 1997
Engine				
Engine type/code.....	XD3 155 OHV 51kW	XUD11ATE/W PBA 12V 80kW	XUD11ATEY PHZ 12V 80kW	XUD11ATE/L P8B 12V 80kW
Capacity (cm ³) / cylinders.....	2498 / 4	2088 / 4	2088 / 4	2088 / 4
Compression ratio / pressure.....bar	23.0 / _	21.5 / _	21.5 / _	21.5 /
Torque output.....Nm	0	234	234	234
Oil pressure.....idle [running] bar	1.5	1.3 [3.5 @ 4000]	1.3 [3.5 @ 4000]	[2.5 @ 2000]
Oil temperature.....°C	90	80	80	80
Valve clearances - inlet (mm).....	0.15	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm).....	0.25	0: Hyd.	0: Hyd.	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature.....°C	81	85	85	85
Radiator cap pressure.....bar	0.8	1.4	1.4	1.4
Fuel system				
Idle speed.....rpm	750 to 800 [800 to 850]	700 ± 25	675 ± 25	700 ± 25
Maximum (no load) speed.....rpm	4850	5150 ± 125	5150 ± 125	5150
Smoke test/opacity.....M ⁻¹ %	2.5	2.41	3.0	3.0
Static timing method.....	Plunger travel	Refer to wsm	Plunger travel	Dial gauge
Timing dimension.....mm	0.3	Dimension on pump	0.88	0.88
Crankshaft position.....mm [°]	0.72 ± 0.03	-	0 TDC	0 TDC
Turbo type / ref / pressure.....bar	-	Mitsubishi TD04 0.9 bar @ 3000	Mitsubishi TD04 0.9 bar @ 3000	Mitsubishi TD04 0.9 bar @ 3000
Injection pump make.....	Bosch	Roto Diesel	Bosch	Bosch
Injection pump part no.....	2240 R84 or 2250 R84	R8443 B743A	2150 R281	VER 474
Injector Make / type.....	Bosch	Roto Diesel	Bosch	Bosch
Injector part no.....	DNOSD 252	RDN12SDC 6874C	DNOSD 299	DNOSD299
Injection type.....	VE4/9F	Indirect DPC	Indirect VE4/9F	Indirect VER
Injection opening pressure, New [used]...bar	120 ± 5	150 ± 5	175 ± 5	175 ± 5
Glow plugs				
Maker.....	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type.....	0250 201 019 / CH68	0250 201 019 / CH68	0250 201 019 / CH68	0250 201 019 / CH68
Nominal rating.....V/A	11 / 12	11 / 12	11 / 12	11 / 13
Brakes				
minimum friction material thickness				
Front.....mm	1.0	1.0	1.0	1.0
Rear.....mm	1.5	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175x14	185x14	185x14	185x14
Pressure - front / rear - Saloon / Hatch...bar	1.8 / 2.1	2.2 / 2.2	2.2 / 2.2	2.3 / 2.3
- Estate / Van.....bar	1.9 / 2.2	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	3.0 ± 1.0'	1.19 ± 0.5 PW	1.19 ± 0.5 PW	1.42 ± 1.0
Camber.....	-45' ± 30' Est: -30'±30'	-18' ± 30'	-18' ± 30'	-0°18' ± 30'
Castor.....	2°40' ± 30' Est: 2°±30'	2°35' ± 30'	2°35' ± 30'	2°35' ± 30'
King pin inclination.....	9°15' ± 30' Est: 9°±30'	13°38' ± 30'	13°38' ± 30'	13°38' ± 30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	3.0 ± 1.0 Est: 0	1.4 ± 0.3 PW	1.4 ± 0.3 PW	2.8 ± 0.6
Camber.....	-1° ± 30' Est: 0	-1°29' ± 30'	-1°29' ± 30'	-1°29' ± 30'



PEUGEOT

	505 2.5 1982 to 1992	605 2.1 TD 1990 to 1998	605 2.1 TD 1990 to 1993	605 2.1 TD 1993 to 1997
Torque wrench settings				
Cylinder head - stage 1.....Nm	30	35 ²	35 ²	20 ¹
- stage 2.....Nm	70	70	70	60
- stage 3.....Nm	Slacken, 70	+ 150°	+ 150°	+ 180°
- stage 4.....Nm	Warm up, allow to cool			-
- stage 5.....Nm	Slacken, 70	-	-	-
- stage 6.....Nm	+ 120°	-	-	-
Big-end bearings.....Nm	60 N	40 ¹	40 ¹	20 + 70° N
Main bearings.....Nm	120	15 + 60°	15 + 60°	15 + 60°
Crankshaft pulley bolt.....Nm	55 + 60°	40 + 60°	40 + 60°	40 + 60°
Camshaft pulley bolt.....Nm	-	45	45	45
Flywheel [driveplate] bolt.....Nm	15 + 60°	50 LkC	50 LkC	50
Front hubs.....Nm	WSM	345	345	345
Rear hubs.....Nm	280	280	280	280
Wheel nuts / bolts.....Nm	Steel: 60 Alloy: 85	90	90	90
Glow plugs.....Nm	23	22	22	25
Clutch pressure plate bolts.....Nm	20	15	15	15
Injection pump sprocket.....Nm	-	50	50	50
Injectors.....Nm	90	90	90	90
Injection pump mounting bolts.....Nm	20	17	17	20
Injector pipe unions.....Nm	30	23	-	23
Capacities				
Engine oil & filter.....litres	5.0	5.5	6.0	6.0
Gearbox.....litres	BA7: 1.8 BA10: 1.85	BE1: 2.0 BE3: 2.0 ML5T: 1.85	BE1/BE3: 2.0 ML5T: 1.85	1.85
Automatic transmission.....litres	-	-	-	2.0
Final drive.....litres	1.6	WT	WT	WT
Cooling system.....litres	10.0	10.0	10.0	10.0
Fuel tank.....litres	70	80	80	80

Notes

505 2.5 1982 to 1992

¹Estate: 3.5±1.0

605 2.1 TD 1990 to 1998

¹Slacken, 20 + 70° N

²Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤151.5 mm

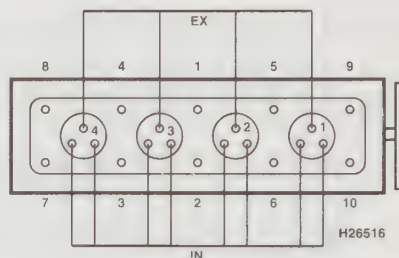
605 2.1 TD 1990 to 1993

¹Slacken, then 20 + 70° N

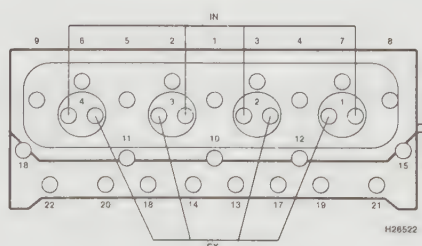
²Bolt length below head: ≤146.5 mm

605 2.1 TD 1993 to 1997

¹Bolt length below head: ≤151.5 mm



2088 cm³



2498 cm³

- Not applicable, or information not available



PEUGEOT

	605 2.1 TD 1994 to 1997	605 2.1 D 1990 to 1993	605 2.1 D 1994 to 1996	605 2.5 TD 1995 to 1998
Engine				
Engine type/code.....	XUD11BTE/L P8C 12V 80kW	XUD11A/W P9A 12V 60kW	XUD11A/L PJZ 12V 60kW	DK5ATE/L/Y THY SOHC 12V 95kW
Capacity (cm ³) / cylinders.....	2088 / 4	2138 / 4	2138 / 4	2446 / 4
Compression ratio / pressure.....bar	21.5 /	22.5 /	22.5 /	21.0 /
Torque outputNm	234	0	0	0
Oil pressureIdle [running] bar	[2.5 @ 2000]	1.4 [3.8 @ 4000]	1.4 [3.8 @ 4000]	[≥3.0]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	85	85	85	-
Radiator cap pressure.....bar	1.4	1.4	1.4	-
Fuel system				
Idle speedrpm	700 ± 25	700 ± 25	700 ± 25	750
Maximum (no load) speedrpm	5150	5150 ± 125	5150 ± 125	5100
Smoke test/opacityM ⁻¹ %	1.54	2.41	2.41	2.5
Static timing method.....	Refer to wsm	Refer to wsm	Refer to wsm	Dial gauge
Timing dimension.....mm	-	Dimension on pump	Dimension on pump	0.52
Crankshaft positionmm [°]	-	-	-	0 TDC
Turbo type / ref / pressure.....bar	Mitsubishi TD04 0.9 bar @ 3000	-	-	-
Injection pump make	Lucas	Roto Diesel	Roto Diesel	Bosch
Injection pump part no.....	DPC	R8443 B733C	R8443 B962C	R520/535
Injector Make / type.....	CAV	Roto Diesel	Roto Diesel	Bosch
Injector part no.....	-	RDN12SDC 6872C	RDN12SDC 6872D	DNOS D312
Injection type.....	Indirect DPC	DPC	DPC	MSA11 3.6 VP36 electronic
Injection opening pressure, New [used]...bar	175 ± 5	130 ± 5	130 ± 5	170 to 175
Glow plugs				
Maker	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type	0250 201 019 / CH68	0250 201 019 / CH68	0250 201 019 / CH68	0250 201 039 / CH163
Nominal rating.....V/A	11 / 13	11 / 12	11 / 12	-
Brakes				
minimum friction material thickness				
Front.....mm	1.0	1.0	1.0	1.0
Rear.....mm	1.5	1.5	1.5	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	205/60x15	195/65x15	195/65x15	195/65x15: 205/60x15
Pressure - front / rear - Saloon / Hatch...bar	2.3 / 2.3	2.2 / 2.2	2.2 / 2.2	2.3 / 2.3
- Estate / Vanbar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.42 ± 1.0	1.19 ± 0.5 PW	1.19 ± 0.5 PW	1.5 ± 1.0
Camber	-0°18' ± 30'	-18' ± 30'	-18' ± 30'	-0°27' ± 30'
Castor	2°35' ± 30'	2°35' ± 30'	2°35' ± 30'	2°47'
King pin inclination.....	13°38' ± 30'	13°38' ± 30'	13°38' ± 30'	13°44' ± 30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.8 ± 0.6	1.4 ± 0.3 PW	1.4 ± 0.3 PW	-
Camber	-1°29' ± 30'	-1°29' ± 30'	-1°29' ± 30'	-



PEUGEOT

	605 2.1 TD 1994 to 1997	605 2.1 D 1990 to 1993	605 2.1 D 1994 to 1996	605 2.5 TD 1995 to 1998
Torque wrench settings				
Cylinder head - stage 1.....Nm	20 ¹	35 ²	35 ²	M10 Bolts≤162.5 mm: 35+120°
- stage 2.....Nm	60	70	70	M12 Bolts≤153.5 mm: 50+120°
- stage 3.....Nm	+ 180°	+ 150°	+ 150°	-
- stage 4.....Nm	-	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	20 + 70° N	40 ¹	40 ¹	20 + 65° N
Main bearings.....Nm	15 + 60°	70	70	20 + 60°
Crankshaft pulley bolt.....Nm	40 + 60°	40 + 60°	40 + 60°	-
Camshaft pulley bolt.....Nm	45	45	45	45
Flywheel [driveplate] bolt.....Nm	50	50 LkC	50 LkC	45
Front hubs.....Nm	345	345	345	345
Rear hubs.....Nm	280	280	280	280
Wheel nuts / bolts.....Nm	90	90	90	90
Glow plugs.....Nm	25	22	22	20
Clutch pressure plate bolts.....Nm	15	15	15	15
Injection pump sprocket.....Nm	50	50	50	10, 25
Injectors.....Nm	90	90	90	55
Injection pump mounting bolts.....Nm	20	17	17	20
Injector pipe unions.....Nm	23	23	23	25
Capacities				
Engine oil & filter.....litres	6.0	5.5	5.5	8.0
Gearbox.....litres	1.85	BE1/BE3: 2.0 ML5T: 1.85	BE1/BE3: 2.0 ML5T: 1.85	1.85
Automatic transmission.....litres	2.0	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	10.0	9.6	9.6	-
Fuel tank.....litres	80	80	80	-

Notes

605 2.1 TD 1994 to 1997

¹Bolt length below head: ≤151.5 mm

605 2.1 D 1990 to 1993

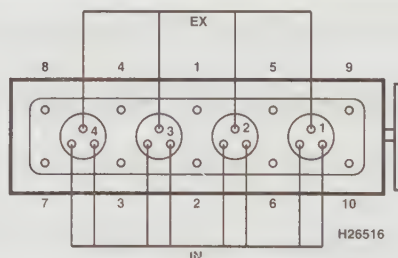
¹Slacken, 20 + 70°

²Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤151.5 mm

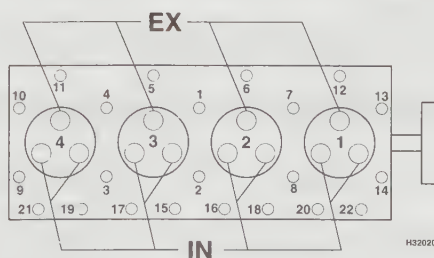
605 2.1 D 1994 to 1996

¹Slacken, 20 + 70°

²Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤151.5 mm



2088 cm³ / 2138 cm³



2446 cm³

- Not applicable, or information not available



PEUGEOT

	806 1.9 TD 1995 to 2000	806 1.9 TD 1995 to 2000	806 2.0 HDi 1999 to 2000	806 2.1 TD 1995 to 1999
Engine				
Engine type/code	XUD9TF/L D8B EGR 67kW	XUD9TF/Y DHX EGR 66kW	DW10ATED/L3 RHZ SOHC 80kW	XUD11BTE P8C SOHC 80kW
Capacity (cm ³) / cylinders	1905 / 4	1905 / 4	1996 / 4	2088 / 4
Compression ratio / pressure	21.8 / _	21.8 / _	18.0 / ≥30.0	21.8 / _
Torque output	202	202	250	0
Oil pressureidle [running] bar	[5.0 @ 4000]	[4.1 @ 2000]	[3.8]	[3.1 @ 2000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.15	0.15 ± 0.04	0: Hyd.	0: Hyd.
- exhaust (mm)	0.30	0.30 ± 0.04	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	83	85	83	85
Radiator cap pressurebar	1.4	1.4	1.4	1.4
Fuel system				
Idle speedrpm	800 ± 50	800 ± 50	850 ± 50	750 ± 50
Maximum (no load) speedrpm	5100	5100	5100	5100
Smoke test/opacityM ⁻¹ %	1.84	2.41	2.0	2.41
Static timing method	Dial gauge	Dial gauge	-	Refer to wsm
Timing dimension.....mm	0.66	0.75	-	-
Crankshaft positionmm [°]	0 TDC	0 TDC	-	-
Turbo type / ref / pressure	-	0.6 to 0.7 bar @ 2000rpm	Garret T15 1.0 bar @ 3000	0.6 to 0.8 bar @ 2000rpm
Injection pump make	Bosch	Bosch	Bosch	Lucas
Injection pump part no.....	VE 4/9F 2250R513	XUDBP02	EDC15C2	XUDLP01
Injector Make / type	Bosch	Bosch	-	CAV
Injector part no.....	DNOSD299	DNOSD299C	-	6751H
Injection type.....	Indirect VE	Indirect	Direct Common Rail	Indirect
Injection opening pressure, New [used]...bar	175	175 ± 5	200 to 1500	145 to 155
Glow plugs				
Maker	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch
Type	0250 201 033 / CH163	0250 201 033 / CH163	0250 202 032 / CH170	0250 201 033
Nominal rating.....V/A	11 / 12	11 / 12	-	11 / 9
Brakes				
minimum friction material thickness				
Front.....mm	8.5 with backing	8.5 with backing	-	8.5 with backing
Rear.....mm	1.5	1.5	-	1.5
Tyres - Saloon / Hatch.....Size	-	-	-	-
- Estate / Van.....Size	205/65x15	205/65x15	205/65x15	205/65x15
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	2.3 / 2.3	2.3 / 2.3	-	2.3 / 2.3
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 ± 1.0	2.0 ± 1.0	2.0 ± 1.0	2.0 ± 1.0
Camber	0° ± 30'	0° ± 30'	0° ± 30'	0° ± 30'
Castor	3°30' ± 30'	3°30' ± 30'	3°30' ± 30'	3°30' ± 30'
King pin inclination.....	11°28' ± 40'	11°28' ± 30'	11°28' ± 30'	11°28' ± 30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 ± 1.0	2.0 ± 1.0	2.0 ± 1.0	2.0 ± 1.0
Camber	-1°0' ± 30'	-1°0' ± 30'	-1°0' ± 30'	-1°0' ± 30'



PEUGEOT

	806 1.9 TD 1995 to 2000	806 1.9 TD 1995 to 2000	806 2.0 HDi 1999 to 2000	806 2.1 TD 1995 to 1999
Torque wrench settings				
Cylinder head - stage 1.....Nm	20 ¹	20 ¹	20 ¹	20 ¹
- stage 2.....Nm	60	60	60	60
- stage 3.....Nm	+ 220°	+ 220°	+ 220°	+ 180°
- stage 4.....Nm	-	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	70	70	25 + 60°	15 + 60°
Crankshaft pulley bolt.....Nm	40 + 60°	40 + 60°	197	70 + 60°
Camshaft pulley bolt.....Nm	45	45	43	45
Flywheel [driveplate] bolt.....Nm	50	50	48	50
Front hubs.....Nm	110	110	100 + 60°	110
Rear hubs.....Nm	99 + 60°	100 + 60°	-	100 + 60°
Wheel nuts / bolts.....Nm	100	100	100	100
Glow plugs.....Nm	22	22	25	22
Clutch pressure plate bolts.....Nm	20	23	-	23
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	90	90	30	90
Injection pump mounting bolts.....Nm	22	22	22.5	22
Injector pipe unions.....Nm	20	20	20	25
Capacities				
Engine oil & filter.....litres	4.0 Steel sump: 4.25	4.0 Steel sump: 4.25	4.5	4.5
Gearbox.....litres	1.85	1.85	1.85	1.85
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	9.0	9.0	-	9.0
Fuel tank.....litres	80	50	50	50

Notes

806 1.9 TD 1995 to 2000

¹Bolt length below head: ≤146.8 mm

806 1.9 TD 1995 to 2000

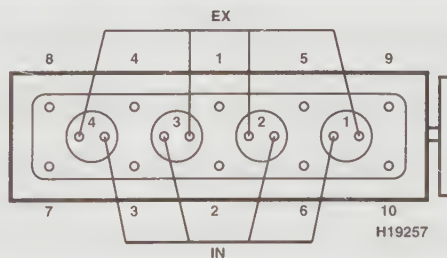
¹Bolt length below head: ≤151.5 mm

806 2.0 HDi 1999 to 2000

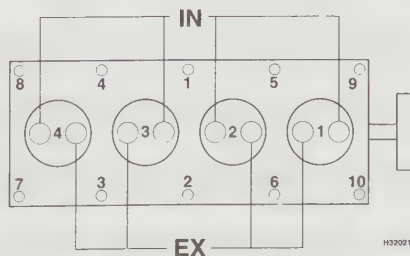
¹Bolt length below head: ≤133.4 mm

806 2.1 TD 1995 to 1999

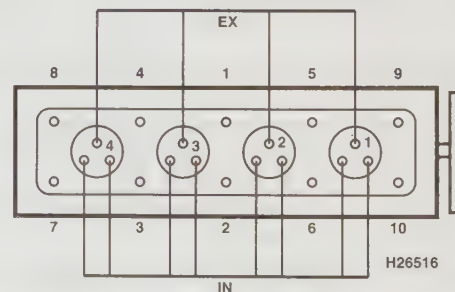
¹Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤151.5 mm



1905 cm³

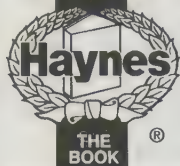


1996 cm³



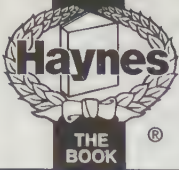
2088 cm³

- Not applicable, or information not available



PEUGEOT

	Expert 1.9 D 1996 to 1999	Expert 1.9 D 1998 to 2000	Expert 1.9 TD 1996 to 2000	Partner 1.7 D 1996 to 2000
Engine				
Engine type/code.....	XUD9A D9B SOHC 51kW	DW8/L3 WJZ SOHC 51kW	XUD9TF/L D8A Turbo 68kW	XUD7A A9A SOHC 44kW
Capacity (cm ³) / cylinders.....	1905 / 4	1868 /	1905 / 4	1769 / 4
Compression ration / pressurebar	23.0 /	23.0 /	21.8 /	23.0 /
Torque outputNm	120	125	196	0
Oil pressureidle [running] bar	[5.0 @ 4000]	1.8 [4.5 @ 4000]	[5.0 @ 4000]	[3.5 @ 4000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.15 ± 0.05	0.15 ± 0.08	0.15 ± 0.05	0.15 ± 0.05
- exhaust (mm)	0.30 ± 0.05	0.30 ± 0.08	0.30 ± 0.05	0.30 ± 0.05
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	TBE	FE	FE
Cooling system				
Thermostat opening temperature°C	83	89	83	83
Radiator cap pressurebar	1.1	1.4	1.1	1.4
Fuel system				
Idle speedrpm	800 ± 50	—	800 ± 50	800 ± 50
Maximum (no load) speedrpm	5150 ± 80	—	5150 ± 80	5150 ± 125
Smoke test/opacityM ⁻¹ %	2.5	2.41	3.0	2.5
Static timing method.....	Dial gauge	—	Dial gauge	Dial gauge
Timing dimension.....mm	1.07 ± 0.02	—	0.66 ± 0.02	Dimension on pump
Crankshaft positionmm [°]	0 TDC	—	0 TDC	0 TDC
Turbo type / ref / pressurebar	—	—	KKK K14 or Garrett T2 ¹	—
Injection pump make	Bosch	Lucas	Bosch	Lucas
Injection pump part no.....	VER 425-10/11	DPC + EGR	R445	X052 8443B930A
Injector Make / type.....	Bosch	—	Bosch	CAV
Injector part no.....	DNOSD299A	—	DNOSD299	LCR 6730705D
Injection type.....	Indirect	—	Indirect	Indirect
Injection opening pressure, New [used]...bar	130	—	175	140
Glow plugs				
Maker	Bosch/Champion	—	Champion	Bosch/Champion
Type	0250 201 019 / CH68	—	CH163	0250 201 033 / CH163
Nominal rating.....V/A	11 / 12	—	11 / 12	11 / 14
Brakes				
minimum friction material thickness				
Front.....mm	8.5 with backing	8.5 with backing	8.5 with backing	8.5 with backing
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/70x14	195/70x14	195/70x14	165/70x14
Pressure - front / rear - Saloon / Hatch...bar	—	—	—	—
- Estate / Vanbar	3.0 / 3.0	3.0 / 3.0	3.0 / 3.0	2.5 / 3.7
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 ± 0.5	1.0 ± 0.5	1.0 ± 0.5	1.0 to 3.0
Camber	0° ± 30'	0° ± 30'	0° ± 30'	0° ± 30'
Castor	3°30' ± 30'	3°30' ± 30'	3°30' ± 30'	3° ± 30'
King pin inclination.....	—	—	—	—
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 ± 0.5	1.0 ± 0.5	1.0 ± 0.5	3.8 to 5.8
Camber	-1° ± 30'	-1° ± 30'	-1° ± 30'	1°15' ± 30'



PEUGEOT

	Expert 1.9 D 1996 to 1999	Expert 1.9 D 1998 to 2000	Expert 1.9 TD 1996 to 2000	Partner 1.7 D 1996 to 2000
Torque wrench settings				
Cylinder head - stage 1.....Nm	20 N	20 ¹	20 N	20 ¹
- stage 2.....Nm	60	60	60	60
- stage 3.....Nm	+ 180°	+ 180° ± 5°	+ 220°	+ 180°
- stage 4.....Nm	-	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	70	70	70	15 + 60°
Crankshaft pulley bolt.....Nm	40 + 60°	40 + 60°	40 + 60°	40 + 60°
Camshaft pulley bolt.....Nm	45	45	45	45
Flywheel [driveplate] bolt.....Nm	50	48	50	65
Front hubs.....Nm	100 + 60°	100 + 60°	100 + 60°	320
Rear hubs.....Nm	100 + 60°	100 + 60°	100 + 60°	275
Wheel nuts / bolts.....Nm	100	100	100	85
Glow plugs.....Nm	22	15	22	22
Clutch pressure plate bolts.....Nm	20	20	20	20
Injection pump sprocket.....Nm	50	23	50	50
Injectors.....Nm	90	90	90	90
Injection pump mounting bolts.....Nm	22	20	22	20
Injector pipe unions.....Nm	22	25	20	20
Capacities				
Engine oil & filter.....litres	4.2	4.5	4.0 STEEL SUMP: 4.25	4.25
Gearbox.....litres	1.85	BE3:2.0 ML5T:1.85 ME5T:1.85	1.85	2.0
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	9.0	7.0	9.0	8.0
Fuel tank.....litres	80	80	80	60

Notes

Expert 1.9 D 1998 to 2000

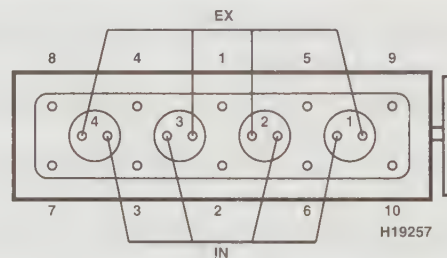
¹Bolt length below head: ≤125.5 mm

Expert 1.9 TD 1996 to 2000

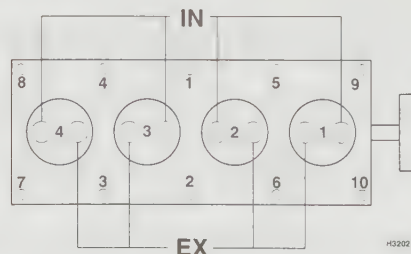
¹0.6 to 0.7 bar @ 2000rpm

Partner 1.7 D 1996 to 2000

¹ Bolt length below head: ≤121.5 mm



1769 cm³ / 1905 cm³



1868 cm³

- Not applicable, or information not available



PEUGEOT

	Partner 1.9 D 1996 to 2000	Partner 1.9 D 1996 to 2000	Partner 1.9 D 1996 to 2000	J5, Express 1.9 1987 to 1991
Engine				
Engine type/code.....	XUD9A/W2 D9B SOHC 52kW	XUD9Y DJY SOHC 50kW	XUD9Y DJY SOHC 50kW	XUD9A D9B SOHC 51kW
Capacity (cm ³) / cylinders.....	1905 / 4	1905 / 4	1905 / 4	1905 / 4
Compression ration / pressurebar	23 /	23 /	23 /	23.0 / _
Torque outputNm	120	120	120	0
Oil pressureidle [running] bar	[3.5 @ 4000]	[3.5 @ 4000]	[3.5 @ 4000]	2.0 [4.5 @ 4000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.15 ± 0.05	0.15 ± 0.05	0.15 ± 0.05	0.15 ± 0.04
- exhaust (mm)	0.30 ± 0.05	0.30 ± 0.05	0.30 ± 0.05	0.30 ± 0.04
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	83	83	83	95
Radiator cap pressurebar	1.4	1.4	1.4	0.9
Fuel system				
Idle speedrpm	750 to 800	750 to 800	750 to 800	750 to 800
Maximum (no load) speedrpm	5150 ± 125	5150 ± 125	5100 ± 125	5150
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Dial gauge	Dial gauge	Dial gauge	Plunger travel
Timing dimension.....mm	0.66	Dimension on pump	0.66 ± 0.02	0.9
Crankshaft positionmm [°]	TDC	0 TDC	0 TDC	0 TDC
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make	Bosch	Lucas	Bosch	Bosch
Injection pump part no.....	VE4/8F230	XUDLP05	VER 425 6	2300 R272-1 or R272-2
Injector Make / type.....	Bosch	CAV	Bosch	Bosch
Injector part no.....	DNOSD299A	LCR6335201D	KCA 17S42	DNOSD 287/ or 287+
Injection type.....	Indirect	Indirect	Indirect	VE4/9F
Injection opening pressure, New [used]...bar	130	140	130	130 ± 5'
Glow plugs				
Maker	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type	0250 201 033 / CH163	0250 201 033 / CH163	0250 201 033 / CH163	0250 201 019 / CH68
Nominal rating.....V/A	11 / 14	11 / 14	11 / 14	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	8.5 with backing	8.5 with backing	8.5 with backing	2.0
Rear.....mm	1.0	1.0	1.0	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	165/70x14	165/70x14	165/70x14	185x14
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	2.5 / 3.7	2.5 / 3.7	2.5 / 3.7	4.3 / 4.5
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 to 3.0	1.0 to 3.0	1.0 to 3.0	-0.5 ± 1.0
Camber	0° ± 30'	0° ± 30'	0° ± 30'	2°20' ± 30'
Castor	3° ± 30'	3° ± 30'	3° ± 30'	30' ± 30'
King pin inclination.....	-	-	-	11°
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	3.8 to 5.8	3.8 to 5.8	3.8 to 5.8	0 ± 1.0
Camber	1°15' ± 30'	1°15' ± 30'	1°15' ± 30'	0



PEUGEOT

	Partner 1.9 D 1996 to 2000	Partner 1.9 D 1996 to 2000	Partner 1.9 D 1996 to 2000	J5, Express 1.9 1987 to 1991
Torque wrench settings				
Cylinder head - stage 1.....Nm	20 ¹	20 ¹	20 ¹	30 N
- stage 2.....Nm	60	60	60	70
- stage 3.....Nm	+ 180°	+ 180°	+ 180°	+ 120°
- stage 4.....Nm	-	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	20 + 70° N	20 + 70° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	15 + 60°	15 + 60°	15 + 60°	70
Crankshaft pulley bolt.....Nm	40 + 60°	40 + 60°	40 + 60°	40 + 60°
Camshaft pulley bolt.....Nm	45	45	45	40
Flywheel [driveplate] bolt.....Nm	65	65	65	50 LkC
Front hubs.....Nm	320	320	320	265
Rear hubs.....Nm	275	275	275	275
Wheel nuts / bolts.....Nm	85	85	85	180
Glow plugs.....Nm	22	22	22	22
Clutch pressure plate bolts.....Nm	20	20	20	25
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	90	90	90	90
Injection pump mounting bolts.....Nm	20	20	20	-
Injector pipe unions.....Nm	20	22	22	-
Capacities				
Engine oil & filter.....litres	4.0 STEEL SUMP: 4.25	4.25	4.25	4.75
Gearbox.....litres	2.0	2.0	2.0	1.6
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	8.0	8.0	8.0	9.5
Fuel tank.....litres	60	60	60	70

Notes

Partner 1.9 D 1996 to 2000

¹Bolt length below head: ≤121.5 mm

Partner 1.9 D 1996 to 2000

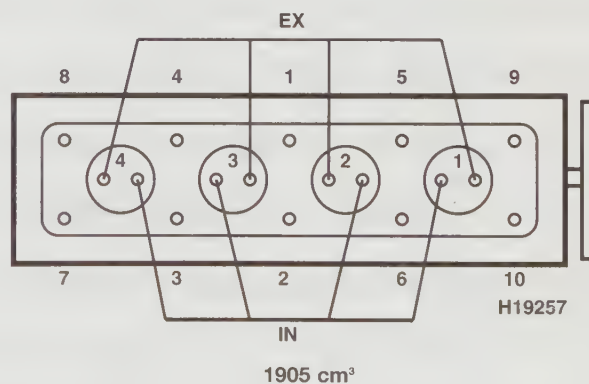
¹Bolt length below head: ≤121.5 mm

Partner 1.9 D 1996 to 2000

¹Bolt length below head: ≤121.5 mm

J5, Express 1.9 1987 to 1991

¹DNOSD287+ with VE49F2300R2722: 135±5

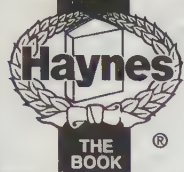


- Not applicable, or information not available



PEUGEOT

	J5, Express 1.9 1987 to 1993	J5, Express 2.5 1987 to 1994	J5, Express 2.5 TD 1987 to 1994	Boxer 1.9 D 1994 to 1997
Engine				
Engine type/code	XUD9A D9B SOHC 51kW	U25 661 OHV 54kW	U25 673 OHV 70kW	XUD9AU D9B SOHC 51kW
Capacity (cm ³) / cylinders	1905 / 4	2500 / 4	2500 / 4	1905 / 4
Compression ratio / pressure	23.0 / _	22.2 / _	21.0 / _	23.0 / _
Torque output	121 Nm	0	0	120
Oil pressureidle [running] bar	2.0 [4.5 @ 4000]	1.0 [4.1 @ 3500]	2.5 [4.2 @ 3500]	2.2 [4.6]
Oil temperature	80 °C	80	80	80
Valve clearances - inlet (mm)	0.15 ± 0.04	0.30	0.30	0.15 ± 0.08
- exhaust (mm)	0.30 ± 0.04	0.20	0.20	0.30 ± 0.08
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature	88 °C	86	86	83
Radiator cap pressure	1.1 bar	1.1	1.1	1.0
Fuel system				
Idle speed	750 to 800 rpm	800 ± 25	750 ± 25	800 +0 -50
Maximum (no load) speed	5150 rpm	4625 ± 125	4600 ± 150	5150 ± 125
Smoke test/opacity	2.5 M ⁻¹ %	2.5	3.0	2.5
Static timing method	Dial gauge	Dial gauge	Dial gauge	Dial gauge
Timing dimension	Dimension on pump	Dimension on pump	Dimension on pump	1.07 ± 0.01
Crankshaft position	0 TDC	[22]	[19]	0 TDC
Turbo type / ref / pressure	-	-	-	-
Injection pump make	Roto Diesel	Roto Diesel	Roto Diesel	Bosch
Injection pump part no.	R8443 B380A or B380B	MA260 R8443 B111A	MAS100 R8443 B123B	VER 4251
Injector Make / type	Roto Diesel	Roto Diesel	Roto Diesel	Bosch
Injector part no.	RDNOSDC 6751C	RDNOSDC 6577B	RDNOSDC 6751	KCA 17 S42 299A
Injection type	DPC	Indirect DPC	DPC	Indirect VER
Injection opening pressure, New [used] ...bar	125 ± 5	122 ± 5	137 ± 5	130
Glow plugs				
Maker	Bosch/Champion	Bosch/Champion	Beru/Champion	Bosch/Beru
Type	0250 201 019 / CH68	0250 201 019 / CH68	0250 201 019 / CH68	0250 201 019 / 0100221133
Nominal rating	11 / 12 V/A	11 / 12	11 / 12	11 / 11
Brakes				
minimum friction material thickness				
Front	2.0 mm	2.0	2.0	2.0
Rear	1.5 mm	1.5	1.5	1.0
Tyres - Saloon / Hatch				
- Estate / Van	185x14	185x14; 195/75x16	185x14; 195/75x16	195/70x15; 205/70x15 ^s
Pressure - front / rear - Saloon / Hatch ...bar	-	-	-	-
- Estate / Van	4.3 / 4.5	Refer to owners handbook	Refer to owners handbook	270: 3.0 / 3.0 ^a
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-)	-0.5 ± 1.0 mm [°]	-0.5 ± 1.0	-0.5 ± 1.0	-2.0 ± 1.0
Camber	2°20' ± 30'	2°20' ± 30' 1800: 1°±30'	2°20' ± 30' 1800: 1°±30'	0° ± 30'
Castor	30° ± 30'	30° ± 30' 1800: 0±30'	30° ± 30' 1800: 0±30'	1° ± 30'
King pin inclination	11°	11°	11°	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-)	0 ± 1.0 mm [°]	0 ± 1.0	0 ± 1.0	0 ± 1.0
Camber	0	0	0	0° ± 10'



PEUGEOT

	J5, Express 1.9 1987 to 1993	J5, Express 2.5 1987 to 1994	J5, Express 2.5 TD 1987 to 1994	Boxer 1.9 D 1994 to 1997
Torque wrench settings				
Cylinder head - stage 1.....Nm	30 N	40 N	40 N	Bolt length: ≤121.5mm ¹
- stage 2.....Nm	70	+ 100°	+ 100°	20
- stage 3.....Nm	+ 120°	+ 100°	+ 100°	60
- stage 4.....Nm	–	Warm up, allow to cool	Warm up, allow to cool	+ 180°
- stage 5.....Nm	–	+ 45°	+ 45°	–
- stage 6.....Nm	–	–	–	–
Big-end bearings.....Nm	20 + 70° N	90 N	90 N	40 slacken, 20 + 70° N
Main bearings.....Nm	70	95	95	70
Crankshaft pulley bolt.....Nm	40 + 60°	250	250	40 + 51°
Camshaft pulley bolt.....Nm	40	32	32	45
Flywheel [driveplate] bolt.....Nm	50 LkC	90 LkC	90 LkC	50
Front hubs.....Nm	265	265	265	450 18Q: 500
Rear hubs.....Nm	275	275	275	WSM
Wheel nuts / bolts.....Nm	180	180	180	160 18Q: 180
Glow plugs.....Nm	22	28	28	20 to 25
Clutch pressure plate bolts.....Nm	25	35	35	20
Injection pump sprocket.....Nm	50	–	–	50
Injectors.....Nm	90	25	25	90
Injection pump mounting bolts.....Nm	–	–	–	20
Injector pipe unions.....Nm	–	25	25	25
Capacities				
Engine oil & filter.....litres	4.75	4.7	4.7	4.25 STEEL SUMP: 5.25
Gearbox.....litres	1.6	1.6 Transfer: 2.4	1.6	1.85
Automatic transmission.....litres	–	–	–	–
Final drive.....litres	WT	4x4: 1.6	WT	WT
Cooling system.....litres	9.5	10.6	10.6	12.0
Fuel tank.....litres	70	70	70	80

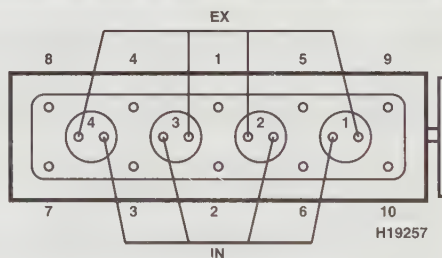
Notes

Boxer 1.9 D 1994 to 1997

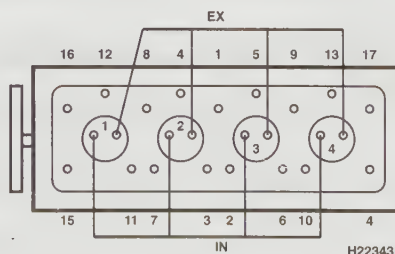
¹Bolt with guide boss: ≤125.5mm

²215/75x15:205/75x15:215/75x16

³310/320: 4.1 / 4.5 350: 4.5 / 4.5



1905 cm³



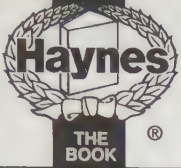
2500 cm³

– Not applicable, or information not available



PEUGEOT

	Boxer 1.9 TD 1994 to 1997	Boxer 1.9 TD 1994 to 2000	Boxer 1.9 D 1998 to 2000	Boxer 2.5 D 1998 to 2000
Engine				
Engine type/code.....	XUD9UTF D8C SOHC Turbo 67kW	XUD9UTF DHX SOHC Turbo 67kW	XUD9AU D9B SOHC 50kW	DJ5 T9A SOHC 12V 63kW
Capacity (cm ³) / cylinders.....	1905 / 4	1905 / 4	1905 / 4	2446 / 4
Compression ratio / pressure.....bar	21.8 / _	21.8 / _	23.0 / _	20.0 / _
Torque output.....Nm	196	196	120	153
Oil pressure.....idle [running] bar	2.4 [4.8]	2.4 [4.8 @ 4000]	2.2 [4.6]	1.8 [3.5 to 4.4 @ 2000]
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0.15 ± 0.08	0.15 ± 0.08	0.15 ± 0.08	0: Hyd.
- exhaust (mm).....	0.30 ± 0.08	0.30 ± 0.08	0.30 ± 0.08	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature.....°C	83	83	83	83
Radiator cap pressure.....bar	1.0	1.0	1.0	1.0
Fuel system				
Idle speed.....rpm	800 +0 -50	850 ± 50	800 ± 50	725 ± 25
Maximum (no load) speed.....rpm	5050 ± 125	5050	5150 ± 125	5200 ± 125
Smoke test/opacity.....M ⁻¹ %	2.41	2.41	2.41	2.5
Static timing method.....	Dial gauge	Dial gauge	-	Peg
Timing dimension.....mm	0.66 ± 0.01	0.66 ± 0.02	1.07 ± 0.01	9.5 Setting rod
Crankshaft position.....mm [°]	0 TDC	0 TDC	TDC	TDC
Turbo type / ref / pressure.....bar	KKK	KKK	-	-
Injection pump make.....	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VER445	VER4452/2	-	-
Injector Make / type.....	Bosch	Bosch	Bosch	Bosch
Injector part no.....	KCA 17 S42 299	KCA 17 S42 299	KCA 17 S42 299A	140 PV 3375 955
Injection type.....	Indirect VER	Indirect VER	VER425/*XUD201	VER 683
Injection opening pressure, New [used]...bar	175	175	130	1st stage: 200. 2nd: 425
Glow plugs				
Maker.....	Bosch/Beru	Bosch/Beru	Bosch/Beru	Beru
Type.....	0250 201 033 / 0100226186	0250 201 033 / 0100226186	0250201019 / 0100221133	0100 226 246
Nominal rating.....V/A	11 / 9	11 / 9	11.0 / _	11 / 9
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/70x15: 205/70x15 ^s	195/70x15: 205/70x15 ^s	195/70x15: 205/70x15 ^s	195/70x15: 205/70x15 ^s
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Van.....bar	270: 3.0 / 3.0 ^a	270: 3.0 / 3.0 ^a	270: 3.0 / 3.0 ^a	270: 3.0 / 3.0 ^a
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-2.0 ± 1.0	-2.0 ± 1.0	-2.0 ± 1.0	-2.0 ± 1.0
Camber.....	0' ± 30'	0'30' ± 30'	0'30' ± 30'	0'30' ± 30'
Castor.....	1° ± 30'	1° ± 30'	1° ± 30'	1° ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.0 ± 1.0	0.0 ± 1.0	0.0 ± 1.0	0.0 ± 1.0
Camber.....	0' ± 10'	0' ± 10'	0' ± 10'	0' ± 10'



PEUGEOT

	Boxer 1.9 TD 1994 to 1997	Boxer 1.9 TD 1994 to 2000	Boxer 1.9 D 1998 to 2000	Boxer 2.5 D 1998 to 2000
Torque wrench settings				
Cylinder head - stage 1.....Nm	20 ¹	20 ¹	20 ¹	Bolt length M10: ≤189.3mm ¹
- stage 2.....Nm	60	60	60	M12: 50 M10: 35
- stage 3.....Nm	+ 220°	+ 220°	+ 180°	+ 150° ± 5°
- stage 4.....Nm	-	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	40 slacken, 20 + 70° N	40 slacken, 20 + 70° N	40 slacken, 20 + 70° N	40, slacken, 20 + 70° N
Main bearings.....Nm	70	70	70	70
Crankshaft pulley bolt.....Nm	40 + 51°	40 + 51°	40 + 51°	40 + 51°
Camshaft pulley bolt.....Nm	45	45	45	45
Flywheel [driveplate] bolt.....Nm	50	50	50	50
Front hubs.....Nm	450 18Q: 500	450 18Q: 500	450 18Q: 500	450 18Q: 500
Rear hubs.....Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	160 18Q: 180	160 18Q: 180	160 18Q: 180	160 18Q: 180
Glow plugs.....Nm	20 to 25	20 to 25	20 to 25	20 to 25
Clutch pressure plate bolts.....Nm	20	20	20	20
Injection pump sprocket.....Nm	50	50	-	-
Injectors.....Nm	90	90	90	-
Injection pump mounting bolts.....Nm	20	20	-	-
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	5.25 A/C: 4.25	5.25 A/C: 4.25	4.25 STEEL SUMP: 5.25	5.25 A/C: 4.25
Gearbox.....litres	1.85	1.85	1.85	1.85
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	12.0	12.0	12.0	13.0 A/C: 13.5
Fuel tank.....litres	80	80	80	80

Notes

Boxer 1.9 TD 1994 to 1997

¹Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤150.5 mm

*215/75x15: 205/75x15: 215/75x16

*310/320: 4.1 / 4.5 350: 4.5 / 4.5

Boxer 1.9 TD 1994 to 2000

¹Bolt length below head: ≤146.5 mm Bolt with guide boss: ≤150.5 mm

*215/75x15: 205/75x15: 215/75x16

*310/320: 4.1 / 4.5 350: 4.5 / 4.5

Boxer 1.9 D 1998 to 2000

¹Bolt length below head: ≤121.5 mm Bolt with guide boss: ≤125.5 mm

*215/75x15: 205/75x15: 215/75x16

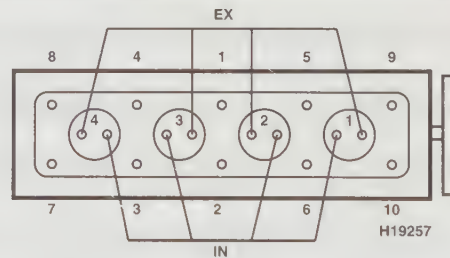
*310/320: 4.1 / 4.5 350: 4.5 / 4.5

Boxer 2.5 D 1998 to 2000

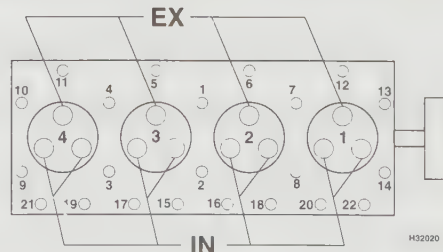
¹M12: ≤178.3mm

*215/75x15: 205/75x15: 215/75x16

*310/320: 4.1 / 4.5 350: 4.5 / 4.5



1905 cm³



2446 cm³

- Not applicable, or information not available



PEUGEOT

	Boxer 2.5 TD 1997 to 2000	Boxer 2.5 TD 1994 to 1997		
Engine				
Engine type/code.....	DJ5TED THX SOHC 12V 79kW	DJ5T THZ SOHC 12V 76kW		
Capacity (cm ³) / cylinders.....	2446 / 4	2446 / 4		
Compression ratio / pressure.....bar	20.0 / _	21.0 / _		
Torque outputNm	225	232		
Oil pressureidle [running] bar	1.8 [3.5 to 4.4]	1.8 [3.5 to 4.4]		
Oil temperature°C	80	80		
Valve clearances - inlet (mm).....	0: Hyd.	0: Hyd.		
- exhaust (mm).....	0: Hyd.	0: Hyd.		
Injection order.....	1-3-4-2	1-3-4-2		
No. 1 cylinder position.....	FE	FE		
Cooling system				
Thermostat opening temperature°C	83	83		
Radiator cap pressurebar	1.0	1.0		
Fuel system				
Idle speedrpm	850 ± 50	725 ± 25		
Maximum (no load) speedrpm	4900 ± 160	4900 ± 160		
Smoke test/opacityM ⁻¹ %	3.0	3.0		
Static timing method.....	Peg	Refer to wsm		
Timing dimension.....mm	9.5 Setting rod	-		
Crankshaft positionmm [°]	TDC	-		
Turbo type / ref / pressurebar	KKK K16 0.9 bar @ 2500rpm	KKK K16 0.9 bar @ 2500rpm		
Injection pump make.....	Bosch	Lucas		
Injection pump part no.....	-	R8444		
Injector Make / type.....	Bosch	CAV		
Injector part no.....	140 PV 3375 955	LDC 003R		
Injection type.....	VER 683	Indirect DPC		
Injection opening pressure, New [used]...bar	1st stage: 200. 2nd: 425	168 to 173		
Glow plugs				
Maker.....	Beru	Beru/Champion		
Type.....	0100 226 246	0100 226 246 / CH163		
Nominal rating.....V/A	11 / 9	11 / 9		
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0		
Rear.....mm	1.0	1.0		
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/70x15: 205/70x15 ³	195/70x15: 205/70x15 ³		
Pressure - front / rear - Saloon / Hatch...bar	-	-		
- Estate / Vanbar	3.0 / 3.0 ⁴	3.0 / 3.0 ⁴		
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-2.0 ± 1.0	-2.0 ± 1.0		
Camber.....	0°30' ± 30'	0°30' ± 30'		
Castor.....	1° ± 30'	1° ± 30'		
King pin inclination.....	-	-		
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.0 ± 1.0	0.0 ± 1.0		
Camber.....	0° ± 10'	0° ± 10'		



PEUGEOT

	Boxer 2.5 TD 1997 to 2000	Boxer 2.5 TD 1994 to 1997		
Torque wrench settings				
Cylinder head - stage 1	Nm Bolt length M10: ≤189.3mm ¹	Nm Bolt length M10: ≤162.5mm ¹		
- stage 2	Nm M12: 50 M10: 35	Nm M12: 50 M10: 35		
- stage 3	Nm + 150° ± 5°	Nm + 120° ± 5°		
- stage 4	Nm -	Nm -		
- stage 5	Nm -	Nm -		
- stage 6	Nm -	Nm -		
Big-end bearings	Nm 40, slacken, 20 + 70° N	Nm 40, slacken, 20 + 70° N		
Main bearings	Nm 70	Nm 70		
Crankshaft pulley bolt	Nm 40 + 51°	Nm 40 + 51°		
Camshaft pulley bolt	Nm 45	Nm 45		
Flywheel [driveplate] bolt	Nm 50	Nm 45		
Front hubs	Nm 450 18Q: 500	Nm 450 18Q: 500		
Rear hubs	Nm WSM	Nm WSM		
Wheel nuts / bolts	Nm 160 18Q: 180	Nm 160 18Q: 180		
Glow plugs	Nm 20 to 25	Nm 20 to 25		
Clutch pressure plate bolts	Nm 20	Nm 20		
Injection pump sprocket	Nm -	Nm -		
Injectors	Nm 55	Nm 55		
Injection pump mounting bolts	Nm -	Nm -		
Injector pipe unions	Nm 25	Nm 25		
Capacities				
Engine oil & filter	litres 8.0	litres 8.0		
Gearbox	litres 1.85	litres 1.85		
Automatic transmission	litres -	litres -		
Final drive	litres WT	litres WT		
Cooling system	litres 13.0 A/C: 13.5	litres 13.0 A/C: 13.5		
Fuel tank	litres 80	litres 80		

Notes

Boxer 2.5 TD 1997 to 2000

¹M12: ≤178.3mm

²215/75x15: 205/75x15: 215/75x16

³320: 4.1 / 4.5 350: 4.5 / 4.5

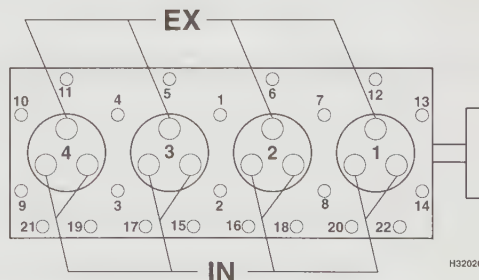
⁴1999 on: W3

Boxer 2.5 TD 1994 to 1997

¹M12: ≤153.5mm

²215/75x15: 205/75x15: 215/75x16

³320: 4.1 / 4.5 350: 4.5 / 4.5



2446 cm³

- Not applicable, or information not available



PROTON

	Persona 2.0 D 1996 to 1997	Persona 2.0 TD 1997 to 2000		
Engine				
Engine type/code.....	4D68 SOHC 48kW	4D68 SOHC Turbo 59kW		
Capacity (cm ³) / cylinders.....	1998 / 4	1998 / 4		
Compression ratio / pressure.....bar	22.4 / 25.6	22.2 / 25.6		
Torque outputNm	0	172		
Oil pressureidle [running] bar	—	—		
Oil temperature°C	—	—		
Valve clearances - inlet (mm)	0.25 H	0.25 H		
- exhaust (mm)	0.25 H	0.25 H		
Injection order	1-3-4-2	1-3-4-2		
No. 1 cylinder position	—	—		
Cooling system				
Thermostat opening temperature°C	76.5	76.5		
Radiator cap pressurebar	0.75 to 1.05	0.75 to 1.05		
Fuel system				
Idle speedrpm	750 ± 100	750 ± 100		
Maximum (no load) speedrpm	—	—		
Smoke test/opacityM ⁻¹ %	1.6	2.5		
Static timing method.....	Dial gauge	Dial gauge		
Timing dimension.....mm	0.97 to 1.03	0.97 to 1.03		
Crankshaft positionmm [°]	9 ATDC	10 ATDC		
Turbo type / ref / pressurebar	—	—		
Injection pump make	Nippon Denso	Nippon Denso		
Injection pump part no.....	MD 189552	—		
Injector Make / type	Nippon Denso	Nippon Denso		
Injector part no.....	—	ND189552		
Injection type.....	Indirect	Indirect		
Injection opening pressure, New [used]...bar	117 to 127	117 to 127		
Glow plugs				
Maker	—	—		
Type	—	—		
Nominal rating.....V/A	—	—		
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0		
Rear.....mm	1.0	1.0		
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185/60x14	185/60x14		
Pressure - front / rear - Saloon / Hatch...bar	2.1 / 2.0	2.1 / 2.0		
- Estate / Van.....bar	—	—		
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 3.0	0 ± 3.0		
Camber	0°30'	0°30'		
Castor	2°15'	2°15'		
King pin inclination.....	12°49'	12°49'		
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	—	—		
Camber	-0°40' ± 30'	-0°40' ± 30'		



PROTON

	Persona 2.0 D 1996 to 1997	Persona 2.0 TD 1997 to 2000		
Torque wrench settings				
Cylinder head - stage 1.....Nm	40 ¹	40 ¹		
- stage 2.....Nm	+ 90°	+ 90°		
- stage 3.....Nm	+ 90°	+ 90°		
- stage 4.....Nm	-	-		
- stage 5.....Nm	-	-		
- stage 6.....Nm	-	-		
Big-end bearings.....Nm	20 + 90° N	20 + 90° N		
Main bearings.....Nm	25 + 90°	25 + 90°		
Crankshaft pulley bolt.....Nm	120	120		
Camshaft pulley bolt.....Nm	90	90		
Flywheel [driveplate] bolt.....Nm	135	135		
Front hubs.....Nm	230	230		
Rear hubs.....Nm	180 N	180 N		
Wheel nuts / bolts.....Nm	100	100		
Glow plugs.....Nm	18	18		
Clutch pressure plate bolts.....Nm	20	20		
Injection pump sprocket.....Nm	85	85		
Injectors.....Nm	55	55		
Injection pump mounting bolts.....Nm	24	24		
Injector pipe unions.....Nm	30	30		
Capacities				
Engine oil & filter.....litres	5.1	5.1		
Gearbox.....litres	1.8	1.8		
Automatic transmission.....litres	-	-		
Final drive.....litres	WT	WT		
Cooling system.....litres	8.0	8.0		
Fuel tank.....litres	50	50		

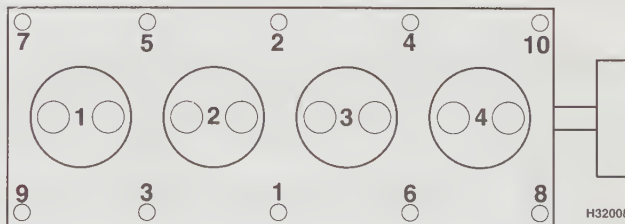
Notes

Persona 2.0 D 1996 to 1997

¹Bolt length below head ≤119.7 mm

Persona 2.0 TD 1997 to 2000

¹Bolt length below head ≤119.7 mm



1998 cm³

- Not applicable, or information not available



RENAULT

	5 & Extra (B/C/F/S404) 1986 to 1994	5 & Extra (B/C/F/S404) 1986 to 1994	5 & Extra D 1992 to 1996	5 & Extra D 1992 to 1996
Engine				
Engine type/code.....	F8M720 / 730 SOHC 40kW	F8M720 / 730 SOHC 40kW	F8Q776 SOHC 48kW	F8Q722 SOHC 48kW
Capacity (cm ³) / cylinders.....	1596 / 4	1596 / 4	1870 / 4	1870 / 4
Compression ratio / pressure.....bar	22.5 / ≥20.0	22.5 / ≥20.0	21.5 / ≥20.0	21.5 / ≥20.0
Torque output.....Nm	0	0	118	118
Oil pressure.....idle [running] bar	2.0 [3.5 @ 3000]	2.0 [3.5 @ 3000]	2.0 [3.5 @ 3000]	2.0 [3.5 @ 3000]
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0.20	0.20	0.20	0.20
- exhaust (mm).....	0.40	0.40	0.40	0.40
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature.....°C	83	83	82	82
Radiator cap pressure.....bar	0.9	0.9	1.2	1.2
Fuel system				
Idle speed.....rpm	850 ± 25	850 ± 25	825 ± 25	825 ± 25
Maximum (no load) speed.....rpm	5200 to 5400	5200 to 5400	5200 ± 100	5200 ± 100
Smoke test/opacity.....M ⁻¹ %	1.2	1.38	1.38	1.38
Static timing method.....	Plunger travel	Rotor lift	Dial gauge	Refer to wsm
Timing dimension.....mm	0.65 ± 0.02	Dimension on pump	0.9 ± 0.02	Dimension on pump
Crankshaft position.....mm [°]	[0] TDC	[0] TDC	0 TDC	-
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	Bosch	Roto Diesel	Bosch	Lucas
Injection pump part no.....	VER 95 0460 494 105	DPC	VER458	R8444B 230A
Injector Make / type.....	Bosch	Roto Diesel	Bosch	CAV
Injector part no.....	0432 217 099	RDNOSDC 6843, 6834C	0432 217 258	RDN4SDC6868D
Injection type.....	Indirect VER	DPCR 8443 B372A, B373B, B375B	Indirect VER	Indirect DPC
Injection opening pressure, New [used]...bar	130 +8 -5	118 +7 -5	125 to 138	118
Glow plugs				
Maker.....	Bosch/Champion	Champion	Bosch/Champion	Bosch/Champion
Type.....	0250 201 013 / CH155	CH88 / CH137	0250 201 029 / CH155	0250 201 029 / CH155
Nominal rating.....V/A	11 / 12	11 / 12	11 / 15	11 / 15
Brakes				
minimum friction material thickness				
Front.....mm	6.0 with backing	6.0 with backing	7.0 with backing	7.0 with backing
Rear.....mm	2.5 with backing	2.5 with backing	2.5 with backing	2.5 with backing
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	145/70x13:155/70x13:165/65x13	145/70x13:155/70x13:165/65x13	-	-
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.2	2.2 / 2.2	-	-
- Estate / Van.....bar	2.2 / 2.2'	2.2 / 2.2'	2.4 / 2.5	2.4 / 2.5
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.0 ± 1.0	-1.0 ± 1.0	-1.0 ± 1.0	-1.0 ± 1.0
Camber.....	15' ± 30'	15' ± 30'	0°20' ± 40'	0°20' ± 40'
Castor.....	2° ± 30'	2° ± 30'	WSM	WSM
King pin inclination.....	12°40' ± 30'	12°40' ± 30'	12°45' ± 45'	12°45' ± 45'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 to 3.0	0 to 3.0	-1.5 ± 1.5	-1.5 ± 1.5
Camber.....	-50' ± 30'	-50' ± 30'	-0°50' ± 30'	-0°50' ± 30'



RENAULT

5 & Extra (B/C/F/S404)
1986 to 1994

5 & Extra (B/C/F/S404)
1986 to 1994

5 & Extra D
1992 to 1996

5 & Extra D
1992 to 1996

Torque wrench settings

Cylinder head - stage 1	Nm	30 N	30 N	30 N	30 N
- stage 2	Nm	70	70	+ 80°	+ 80°
- stage 3	Nm	Wait 3 mins	Wait 3 mins	Wait 3 mins	Wait 3 mins
- stage 4	Nm	Slacken	Slacken	Slacken	Slacken
- stage 5	Nm	20	20	25	25
- stage 6	Nm	+ 123°	+ 123°	+ 213°	+ 213°
Big-end bearings	Nm	45 to 50 N	45 to 50 N	50 N	50 N
Main bearings	Nm	60 to 65	60 to 65	65	65
Crankshaft pulley bolt	Nm	90 to 100	90 to 100	100	100
Camshaft pulley bolt	Nm	50	50	50	50
Flywheel [driveplate] bolt	Nm	50 to 55	50 to 55	55	55
Front hubs	Nm	250	250	250	250
Rear hubs	Nm	160	160	175	175
Wheel nuts / bolts	Nm	80	80	90	90
Glow plugs	Nm	15 to 30	15 to 30	20	20
Clutch pressure plate bolts	Nm	25	25	40	40
Injection pump sprocket	Nm	50	50	50	50
Injectors	Nm	65 to 75	65 to 75	70	70
Injection pump mounting bolts	Nm	-	-	25	25
Injector pipe unions	Nm	25	25	25	25

Capacities

Engine oil & filter	litres	5.3	5.3	5.5	5.5
Gearbox	litres	JB1: 3.4 JB5: 2.9	JB1: 3.4 JB5: 2.9	3.4	3.4
Automatic transmission	litres	-	-	-	-
Final drive	litres	WT	WT	WT	WT
Cooling system	litres	6.5	6.5	7.2	7.2
Fuel tank	litres	43	43	43	43

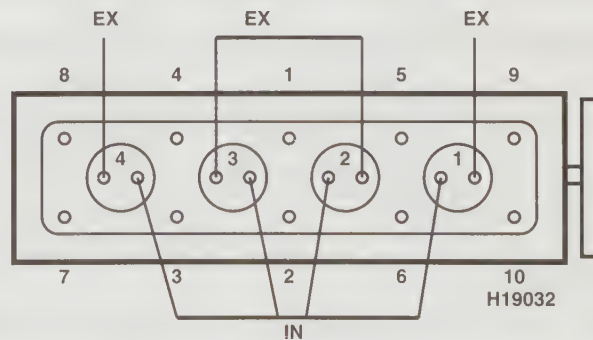
Notes

5 & Extra (B/C/F/S404) 1986 to 1994

'Extra: 2.1 / 2.5

5 & Extra (B/C/F/S404) 1986 to 1994

'Extra: 2.1 / 2.5



1596 cm³ / 1870 cm³

- Not applicable, or information not available



RENAULT

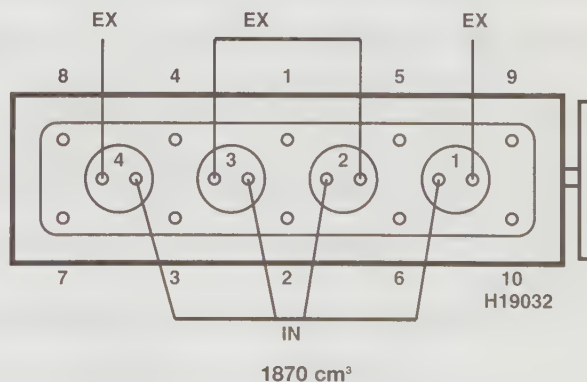
	Clio 1.9 D 1991 to 1998	Clio 1.9 D 1992 to 1998	Clio 1.9 D 1991 to 1998	Clio 1.9 D 1995 to 1998
Engine				
Engine type/code	F8Q732 SOHC 48kW	F8Q714 SOHC 48kW	F8Q730 SOHC 48kW	F8Q678 SOHC 48kW
Capacity (cm ³) / cylinders	1870 / 4	1870 / 4	1870 / 4	1870 / 4
Compression ratio / pressure	21.5 / ≥20.0	21.5 / ≥20.0	21.5 / ≥20.0	21.5 / ≥20.0
Torque output	118	118	118	118
Oil pressureidle [running] bar	1.2 [3.5 @ 4000]	1.2 [3.5 @ 4000]	1.2 [3.5 @ 4000]	1.2 [3.5 @ 4000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.20	0.20	0.20	0.20
- exhaust (mm)	0.40	0.40	0.40	0.40
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	82	82	82	82
Radiator cap pressure	1.2 or 1.8	1.2 or 1.8	1.2 or 1.8	1.2 or 1.8
Fuel system				
Idle speedrpm	825 ± 25	825 ± 25	825 ± 25	825 ± 25
Maximum (no load) speedrpm	5200	5200	5200	5200
Smoke test/opacityM ⁻¹ %	1.38	1.17	2.41	0.96
Static timing method.....	Plunger travel	Dial gauge	Dial gauge	Dial gauge
Timing dimension.....mm	0.7	Dimension on pump	Dimension on pump	0.9 ± 0.02
Crankshaft positionmm [°]	0 TDC	0 TDC	0 TDC	0 TDC
Turbo type / ref / pressure	-	-	-	-
Injection pump make	Bosch	Lucas	Roto Diesel	Bosch
Injection pump part no.....	VE 4/8 R317/5	DPC R8444B080A/B	DPC R8444B690A	VE 4/8F R588
Injector Make / type	Bosch	CAV	Roto Diesel	Bosch
Injector part no.....	DNOSD302	RDN4SDC6886D	LCR 67334	KCA 17S42
Injection type.....	Indirect VE	Indirect DPC	Indirect DPC	Indirect VE
Injection opening pressure, New [used]...bar	125 to 140	113 to 125	113 to 125	125 to 138
Glow plugs				
Maker	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type	0250 201 029 / CH155	0250 201 029 / CH155	0250 201 029 / CH155	0250 201 029 / CH155
Nominal rating.....V/A	11 / 15	11 / 15	11 / 15	11 / 15
Brakes				
minimum friction material thickness				
Front.....mm	6.0 with backing	6.0 with backing	6.0 with backing	6.0 with backing
Rear.....mm	2.5 with backing	2.5 with backing	2.5 with backing	2.5 with backing
Tyres - Saloon / Hatch.....Size	155/70x13: 165/65x13	155/70x13: 165/65x13	155/70x13: 165/65x13	155/70x13: 165/65x13
- Estate / Van.....Size	-	-	-	-
Pressure - front / rear - Saloon / Hatch...bar	2.4 / 2.4	2.4 / 2.4	2.4 / 2.4	2.4 / 2.4
- Estate / Vanbar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.0 ± 1.0	-1.0 ± 1.0	-1.0 ± 1.0	-1.0 ± 1.0
Camber	WSM	WSM	WSM	WSM
Castor	WSM	WSM	WSM	WSM
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.5 ± 1.0 PW	1.5 ± 1.0 PW	1.5 ± 1.0 PW	1.5 ± 1.0 PW
Camber	-0°50' ± 30'	-0°50' ± 30'	-0°50' ± 30'	-0°50' ± 30'



RENAULT

	Clio 1.9 D 1991 to 1998	Clio 1.9 D 1992 to 1998	Clio 1.9 D 1991 to 1998	Clio 1.9 D 1995 to 1998
Torque wrench settings				
Cylinder head - stage 1Nm	30 N	30 N	30 N	30 N
- stage 2Nm	+ 80°	+ 80°	+ 80°	+ 80°
- stage 3Nm	Wait 3 mins	Wait 3 mins	Wait 3 mins	Wait 3 mins
- stage 4Nm	Slacken	Slacken	Slacken	Slacken
- stage 5Nm	25	25	25	25
- stage 6Nm	+ 213°	+ 213°	+ 213°	+ 213°
Big-end bearings.....Nm	50 N	50 N	50 N	50 N
Main bearings.....Nm	65	65	65	65
Crankshaft pulley boltNm	95	95	95	95
Camshaft pulley boltNm	50	50	50	50
Flywheel [driveplate] bolt.....Nm	55	55	55	55
Front hubsNm	250	250	250	250
Rear hubsNm	160	160	160	160
Wheel nuts / boltsNm	90	90	90	90
Glow plugsNm	20	20	20	20
Clutch pressure plate boltsNm	25	25	25	25
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	70	70	70	70
Injection pump mounting boltsNm	—	—	—	—
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	5.5	5.5	5.5	5.5
Gearbox.....litres	3.4	3.4	3.4	3.4
Automatic transmissionlitres	—	—	—	—
Final drivelitres	WT	WT	WT	WT
Cooling system.....litres	6.6	6.6	6.6	6.6
Fuel tank.....litres	43	43	43	43

Notes





RENAULT

	Clio 1.9 (B/C/SBOE/J/N/R) 1998 to 2000	19 & Chamade (B/C/L/S534) 1989 to 1996	19 & Chamade (B/C/L/S534) 1990 to 1996	19 & Chamade (B/C/L/S534) 1992 to 1996
Engine				
Engine type/code.....	F8Q630 SOHC 48kW	F8Q706 SOHC 47kW	F8Q706 SOHC 47kW	F8Q706 SOHC 47kW
Capacity (cm ³) / cylinders.....	1870 / 4	1870 / 4	1870 / 4	1870 / 4
Compression ratio / pressure.....bar	21.5 /	21.5 / ≥20.0	21.5 / ≥20.0	21.5 / ≥20.0
Torque output.....Nm	118	118	118	118
Oil pressure.....idle [running] bar	1.2 [3.5 @ 3000]	2.0 [3.5 @ 3000]	2.0 [3.5 @ 3000]	2.0 [3.5 @ 3000]
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0.10	0.20	0.20	0.20
- exhaust (mm).....	0.25	0.40	0.40	0.40
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature.....°C	89	89	89	89
Radiator cap pressure.....bar	1.2	1.2	1.2	1.2
Fuel system				
Idle speed.....rpm	850 ± 25	825 ± 25	825 ± 25	825 ± 25
Maximum (no load) speed.....rpm	5100 ± 100	5200	5100	5100
Smoke test/opacity.....M ⁻¹ %	1.11	1.38	1.46	2.5
Static timing method.....	Refer to wsm	Plunger travel	Rotor lift	Dial gauge
Timing dimension.....mm	-	0.7 ± 0.02	Dimension on pump	0.82 ± 0.02
Crankshaft position.....mm [°]	-	[0] TDC	[0] TDC	[0] TDC
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	Lucas	Bosch	Roto Diesel	Bosch
Injection pump part no.....	8448B171 A/231A	VE 4/9 R317	R8443 B700A	VER 458-2
Injector Make / type.....	-	Bosch	Roto Diesel	Bosch
Injector part no.....	Lucas RDNOSDC 6902	0432 171 192	RDN4SDC 6868C	0432 217 258
Injection type.....	Indirect	Indirect VE	Indirect DPC	Indirect VER
Injection opening pressure, New [used]...bar	130 ± 5	125 to 138	118 +7 -5	125 to 138
Glow plugs				
Maker.....	Beru	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type.....	-	0250 201 013 / CH155	0250 201 013 / CH155	0250 201 029 / CH155
Nominal rating.....V/A	-	11 / 12	11 / 12	11 / 15
Brakes				
minimum friction material thickness				
Front.....mm	6.0 with backing	6.0 with backing	6.0 with backing	6.0 with backing
Rear.....mm	-	2.5 with backing	2.5 with backing	2.5 with backing
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	165/60x14	165/70x13: 155/80x13	165/70x13: 155/80x13	165/70x13: 155/80x13
Pressure - front / rear - Saloon / Hatch...bar	165/65x13	165/70x13	165/70x13	165/70x13
- Estate / Van.....bar	2.2 / 2.0	2.2 / 2.2	2.2 / 2.2	2.2 / 2.2
	2.5 / 2.5	2.2 / 2.2	2.2 / 2.2	2.2 / 2.2
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.6 ± 2.0°	-1.0 ± 1.0	-1.0 ± 1.0	-1.0 ± 1.0
Camber.....	-0°45' ± 30'	-5' ± 30'	-5' ± 30'	-5' ± 30'
Castor.....	2°30' ± 30'	1°55' PAS: 4°	1°55' PAS: 4°	1°55' PAS: 4°
King pin inclination.....	12°0' ± 30'	12°55' ± 30'	12°55' ± 30'	12°55' ± 30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-3.0 ± 3.0	1.0 to 3.0	1.0 to 3.0	1.0 to 3.0
Camber.....	-0°42' ± 20'	-50' ± 30'	-50' ± 30'	-50' ± 30'



RENAULT

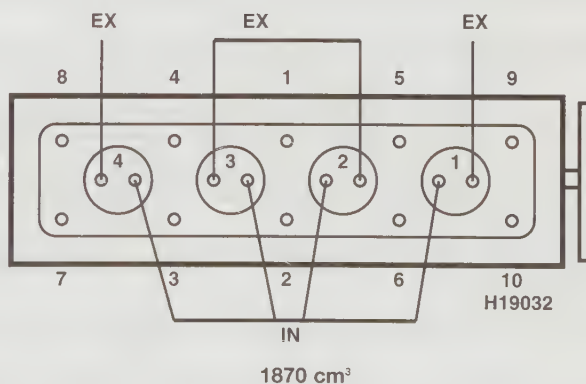
	Clio 1.9 (B/C/SBOE/J/N/R) 1998 to 2000	19 & Chamade (B/C/L/S534) 1989 to 1996	19 & Chamade (B/C/L/S534) 1990 to 1996	19 & Chamade (B/C/L/S534) 1992 to 1996
Torque wrench settings				
Cylinder head - stage 1Nm	30 + 80° N	30 N	30 N	30 N
- stage 2Nm	slacken ¹	70	70	70
- stage 3Nm	25	Wait 3 mins	Wait 3 mins	Wait 3 mins
- stage 4Nm	+ 213°	Slacken	Slacken	Slacken
- stage 5Nm	—	20	20	20
- stage 6Nm	—	+ 123°	+ 123°	+ 123°
Big-end bearingsNm	50 N	45 to 50 N	45 to 50 N	45 to 50 N
Main bearingsNm	60 N	60 to 65	60 to 65	60 to 65
Crankshaft pulley boltNm	20 + 115° ± 15°	90 to 100	90 to 100	90 to 100
Camshaft pulley boltNm	50	50	50	50
Flywheel [driveplate] boltNm	20 + 60°	50 to 55	50 to 55	50 to 55
Front hubsNm	280	250	250	250
Rear hubsNm	175	160	160	160
Wheel nuts / boltsNm	90	80	80	80
Glow plugsNm	25	15 to 30	15 to 30	15 to 30
Clutch pressure plate boltsNm	40	25	25	25
Injection pump sprocketNm	15 + 60°	50	50	50
InjectorsNm	70	65 to 75	65 to 75	65 to 75
Injection pump mounting boltsNm	—	—	—	—
Injector pipe unionsNm	—	25	25	25
Capacities				
Engine oil & filterlitres	5.2	5.5	5.5	5.5
Gearboxlitres	3.4	3.4	3.4	3.4
Automatic transmissionlitres	—	—	—	—
Final drivelitres	WT	WT	WT	WT
Cooling systemlitres	7.3	6.0	6.0	6.0
Fuel tanklitres	50	55	55	55

Notes

Clio 1.9 (B/C/SBOE/J/N/R) 1998 to 2000

¹Slacken bolts 1-2, then 25 Nm + 213°. Repeat procedure for bolts 3-4, 5-6, 7-8 and 9-10

²Var: 1.0 ± 1.0





RENAULT

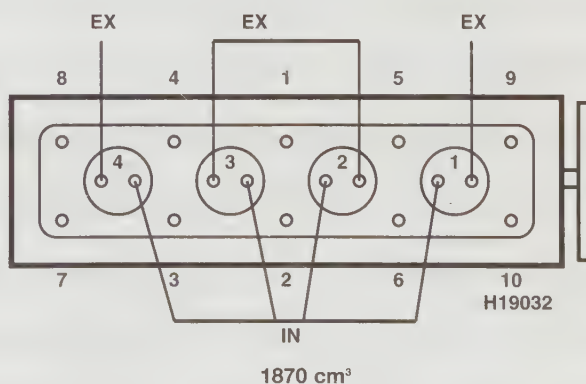
	19 & Chamade (B/C/L/S53I) 1992 to 1996	19 TD (B/C/L/S53K) 1991 to 1996	19 TD (B/C/L/53T) 1992 to 1996	19 TD (B/C/L/S53Z) 1995 to 1996
Engine				
Engine type/code.....	F8Q706 SOHC 47kW	F8Q740 SOHC Turbo 68kW	F8Q744 SOHC Turbo 68kW	F8Q768 SOHC Turbo 68kW
Capacity (cm ³) / cylinders.....	1870 / 4	1870 / 4	1870 / 4	1870 / 4
Compression ratio / pressure.....bar	21.5 / ≥20.0	20.5 /	20.5 /	20.5 /
Torque outputNm	118	175	175	175
Oil pressureidle [running] bar	2.0 [3.5 @ 3000]	1.2 [3.5 @ 3000]	1.2 [3.5 @ 3000]	1.2 [3.5 @ 3000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0.20	0.20	0.20	0.20
- exhaust (mm).....	0.40	0.40	0.40	0.40
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	89	82	82	82
Radiator cap pressurebar	1.2	1.2	1.2	1.2
Fuel system				
Idle speedrpm	825 ± 25	825 ± 25	825 ± 25	825 ± 25
Maximum (no load) speedrpm	5100	4900	4900	4900
Smoke test/opacityM ⁻¹ %	1.38	1.38	2.0	0.87
Static timing method.....	Dial gauge	Dial gauge	Dial gauge	Dial gauge
Timing dimension.....mm	0.82 ± 0.02	Dimension on pump	Dimension on pump	Dimension on pump
Crankshaft positionmm [°]	[0] TDC	0 TDC	0 TDC	0 TDC
Turbo type / ref / pressure.....bar	-	Garrett T2	Garrett T2	Garrett T2
Injection pump make.....	Bosch	Lucas	Lucas	Lucas
Injection pump part no.....	VER 317-6	R8443B783D/E	R8443B871BE	R8444B431A
Injector Make / type.....	Bosch	Roto Diesel	Roto Diesel	Roto Diesel
Injector part no.....	0432 217 258	RDN4 SDC6878C	RDN4 SDC6878C	RDN4 SDC6878D
Injection type.....	Indirect VER	Indirect DPC	Indirect DPC	Indirect DPC
Injection opening pressure, New [used]...bar	125 to 138	125 to 138	125 to 138	125 to 138
Glow plugs				
Maker.....	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type.....	0250 201 029 / CH155	0250 201 031 / CH69	0250 201 031 / CH69	0250 201 031 / CH69
Nominal rating.....V/A	11 / 15	11 / 15	11 / 15	11 / 15
Brakes				
minimum friction material thickness				
Front.....mm	6.0 with backing	6.0 with backing	6.0 with backing	6.0 with backing
Rear.....mm	2.5 with backing	2.5 with backing	2.5 with backing	2.5 with backing
Tyres - Saloon / Hatch.....Size	165/70x13: 155/80x13	175/70x13	175/70x13	175/70x13
- Estate / Van.....Size	165/70x13	-	-	-
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.2	2.2 / 2.2	2.2 / 2.2	2.2 / 2.2
- Estate / Vanbar	2.2 / 2.2	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.0 ± 1.0	-1.0 ± 1.0	-1.0 ± 1.0	-1.0 ± 1.0
Camber.....	-5' ± 30'	WSM	WSM	WSM
Castor.....	1°55' PAS: 4°	WSM	WSM	WSM
King pin inclination.....	12°55' ± 30'	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 to 3.0	1.5 ± 1.0 PW	1.5 ± 1.0 PW	1.5 ± 1.0 PW
Camber.....	-50' ± 30'	-0°50' ± 30'	-0°50' ± 30'	-0°50' ± 30'



RENAULT

	19 & Chamade (B/C/L/S53I) 1992 to 1996	19 TD (B/C/L/S53K) 1991 to 1996	19 TD (B/C/L/53T) 1992 to 1996	19 TD (B/C/L/S53Z) 1995 to 1996
Torque wrench settings				
Cylinder head - stage 1Nm	30 N	30 N	30 N	30 N
- stage 2Nm	70	+ 50°	+ 50°	+ 50°
- stage 3Nm	Wait 3 mins	Wait 3 mins	Wait 3 mins	Wait 3 mins
- stage 4Nm	Slacken	Slacken	Slacken	Slacken
- stage 5Nm	20	25	25	25
- stage 6Nm	+ 123°	+ 213°	+ 213°	+ 213°
Big-end bearings.....Nm	45 to 50 N	50 N	50 N	50 N
Main bearings.....Nm	60 to 65	65	65	65
Crankshaft pulley boltNm	90 to 100	95	95	95
Camshaft pulley boltNm	50	50	50	50
Flywheel [driveplate] bolt.....Nm	50 to 55	55	55	55
Front hubsNm	250	250	250	250
Rear hubsNm	160	160	160	160
Wheel nuts / boltsNm	80	90	90	90
Glow plugsNm	15 to 30	22	22	22
Clutch pressure plate boltsNm	25	25	25	25
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	65 to 75	70	70	70
Injection pump mounting boltsNm	-	-	-	-
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	5.5	5.5	5.5	5.5
Gearbox.....litres	3.4	3.1	3.1	3.1
Automatic transmissionlitres	-	-	-	-
Final drivelitres	WT	WT	WT	WT
Cooling system.....litres	6.0	6.8	6.8	6.8
Fuel tank.....litres	55	55	55	55

Notes



- Not applicable, or information not available

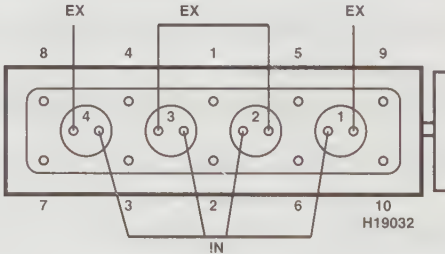
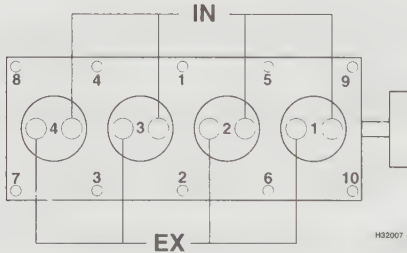


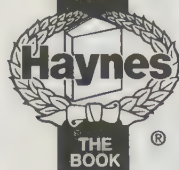
RENAULT

	19 TD (B/C/L/S53K) 1995 to 1996	Megane 1.9 D (B/E/LOA) 1996 to 2000	Megane 1.9 TD (B/E/LOA) 1996 to 1997	Megane 1.9 TDi (B/LAO N) 1998 to 1999
Engine				
Engine type/code.....	F8Q610 SOHC Turbo 68kW	F8Q620 SOHC 48kW	F8Q784 SOHC 66kW	F9Q730/734 SOHC Turbo 74kW
Capacity (cm ³) / cylinders.....	1870 / 4	1870 / 4	1870 / 4	1870 / 4
Compression ratio / pressure.....bar	20.5 /	21.5 /	20.5 /	18.3 /
Torque output.....Nm	175	118	200	200
Oil pressure.....idle [running] bar	1.2 [3.5 @ 3000]	1.2 [3.5 @ 4000]	1.2 [3.5 @ 4000]	1.2 [3.5 @ 4000]
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0.20	0.20	0.20	0.20
- exhaust (mm).....	0.40	0.40	0.40	0.40
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature.....°C	82	82	82	82
Radiator cap pressure.....bar	1.2	1.2	1.2	1.2
Fuel system				
Idle speed.....rpm	825 ± 25	825 ± 25	825 ± 25	825 ± 25
Maximum (no load) speed.....rpm	4900	5200	500	4800 ± 100
Smoke test/opacity.....M ⁻¹ %	0.99	1.24	1.24	1.24
Static timing method.....	Dial gauge	Dial gauge	Dial gauge	Dial gauge
Timing dimension.....mm	Dimension on pump	0.82 ± 0.04	Dimension on pump	0.45 ± 0.02
Crankshaft position.....mm [°]	0 TDC	0 TDC	0 TDC	0 TDC
Turbo type / ref / pressure.....bar	Garrett T2	-	-	Garrett T2
Injection pump make.....	Lucas	Bosch	Lucas	Bosch
Injection pump part no.....	R8444B431A	VE4/8 F2300R598	8448B020A	VE4/11 E2000R6T2
Injector Make / type.....	Roto Diesel	Bosch	CAV	-
Injector part no.....	RDN4 SDC6878D	DNOSD302	LCR 6733402D	DL5A 145 P619
Injection type.....	Indirect DPC	Indirect	Indirect DPC	Direct injection
Injection opening pressure, New [used]...bar	125 to 138	125 to 138	125 to 138	170 to 212
Glow plugs				
Maker.....	Bosch/Champion	Bosch/Champion	Bosch/Champion	Beru
Type.....	0250 201 031 / CH69	0250 201 029 / CH155	0250 201 029 / CH155	GN999
Nominal rating.....V/A	11 / 15	11 / 16	11 / 16	-
Brakes				
minimum friction material thickness				
Front.....mm	6.0 with backing	6.5 with backing	6.5 with backing	6.5 with backing
Rear.....mm	2.5 with backing	1.5	1.5	1.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175/70x13	175/70x13	175/70x13	175/65x13
Pressure - front / rear - Saloon / Hatch....bar	2.2 / 2.2	2.3 / 2.3	2.3 / 2.3	2.2 / 2.4
- Estate / Van.....bar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.0 ± 1.0	[-0°10' ± 10']	[-0°10' ± 10']	[-0°10' ± 10']
Camber.....	WSM	-0°20' ± 30'	-0°20' ± 30'	-0°20' ± 30'
Castor.....	WSM	4° ± 30'	4° ± 30'	4° ± 30'
King pin inclination.....	-	13°21' ± 30'	13°21' ± 30'	13°21' ± 30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.5 ± 1.0 PW	[0°50' ± 20']	[0°50' ± 20']	[0°50' ± 20']
Camber.....	-0°50' ± 30'	-1° ± 15'	-1° ± 15'	-1° ± 15'



RENAULT

	19 TD (B/C/L/S53K) 1995 to 1996	Megane 1.9 D (B/E/LOA) 1996 to 2000	Megane 1.9 TD (B/E/LOA) 1996 to 1997	Megane 1.9 TDi (B/LAO N) 1998 to 1999
Torque wrench settings				
Cylinder head - stage 1.....Nm	30 N	30 + 80° N	30 ¹	30 N
- stage 2.....Nm	+ 50°	slacken ¹	+ 50°	+ 50°
- stage 3.....Nm	Wait 3 mins	25	Wait 3 mins, slacken	Wait 3 mins
- stage 4.....Nm	Slacken	+ 213°	25 + 213°	Slacken
- stage 5.....Nm	25	—	warm up, allow to cool	25
- stage 6.....Nm	+ 213°	—	+ 120°	+ 213° ¹
Big-end bearings.....Nm	50 N	60 N	50 N	50
Main bearings.....Nm	65	60 N	60 N	65
Crankshaft pulley bolt.....Nm	95	20 + 115° ± 15°	20 + 115°	20 + 115°
Camshaft pulley bolt.....Nm	50	50	50	60
Flywheel [driveplate] bolt.....Nm	55	20 + 60°	20 + 60°	50 to 55
Front hubs.....Nm	250	250	250	250
Rear hubs.....Nm	160	175	175	175
Wheel nuts / bolts.....Nm	90	90	90	90
Glow plugs.....Nm	22	20	20	25 to 30
Clutch pressure plate bolts.....Nm	25	40	40	22.5
Injection pump sprocket.....Nm	50	65	65	90
Injectors.....Nm	70	27	70	27
Injection pump mounting bolts.....Nm	—	25	25	—
Injector pipe unions.....Nm	25	25	25	—
Capacities				
Engine oil & filter.....litres	5.5	5.5	5.5	5.5
Gearbox.....litres	3.1	3.4	3.4	3.4
Automatic transmission.....litres	—	—	—	—
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	6.8	7.5	7.5	7.5
Fuel tank.....litres	55	60	60	60
Notes				
<p>Megane 1.9 D (B/E/LOA) 1996 to 2000 ¹Slacken bolts 1-2, then 25 Nm + 213°. Repeat procedure ¹for bolts 3-4, 5-6, 7-8 and 9-10</p> <p>Megane 1.9 TD (B/E/LOA) 1996 to 1997 ¹Apply procedure to each bolt in turn</p> <p>Megane 1.9 TDi (B/LAO N) 1998 to 1999 ¹Apply procedure to each bolt in turn</p>				
 <p>1870 cm³</p>  <p>1870 cm³ (TDi)</p>				
— Not applicable, or information not available				



RENAULT

	Megane 1.9 TDi (B/LA0NM5/2) 1999 to 2000	Scenic 1.9 TD (JAO) 1996	Scenic 1.9 TDi (JAO) 1997 to 1999	21 1.9 D (B/L/K/S48H) 1989 to 1995
Engine				
Engine type/code.....	F9Q SOHC Turbo 74kW	F8Q784 SOHC Turbo 70kW	F9Q730/734 SOHC Turbo 74kW	F8Q710 SOHC 47kW
Capacity (cm ³) / cylinders.....	1870 / 4	1870 / 4	1870 / 4	1870 / 4
Compression ratio / pressure.....bar	18.3 /	20.5 /	18.3 /	21.5 / ≥20.0
Torque output.....Nm	200	175	200	118
Oil pressure.....Idle [running] bar	1.2 [3.5 @ 4000]	[3.5 @ 3000]	[3.5 @ 3000]	2.0 [3.5 @ 3000]
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0.20	0.20	0.20	0.20
- exhaust (mm).....	0.40	0.40	0.40	0.40
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature.....°C	82	82	82	89
Radiator cap pressure.....bar	1.2	1.2	1.2	1.2
Fuel system				
Idle speed.....rpm	825 ± 25	825 ± 25	850 ± 25	825 ± 25
Maximum (no load) speed.....rpm	4800 ± 100	4900	4900	5100 to 5300
Smoke test/opacity.....M ⁻¹ %	2.5	2.5	1.24	0.51
Static timing method.....	—	Dial gauge	Dial gauge	Rotor lift
Timing dimension.....mm	Computer control	Dimension on pump	0.45 ± 0.02	Dimension on pump
Crankshaft position.....mm [°]	—	0 TDC	0 TDC	[0] TDC
Turbo type / ref / pressure.....bar	Garrett T2	—	Garrett T2	—
Injection pump make.....	Bosch	Lucas	Bosch	Roto Diesel
Injection pump part no.....	VE4/11E2000R6T2	8448B020A	VER672	R8443B471C
Injector Make / type.....	—	CAV	Bosch	Roto Diesel
Injector part no.....	DLSA 145 P619	RDN4SDC6878D	DSLA145P619	RDN4SDC 6868C
Injection type.....	Direct, Electronic control	Indirect DPC	Direct VER	Indirect DPC
Injection opening pressure, New [used]...bar	170 to 212	125 to 138	200 to 212	118 +7 -5
Glow plugs				
Maker.....	Champion	Champion	Beru	Bosch/Champion
Type.....	CH172	CH179	GN999	0250 201 006 / CH137
Nominal rating.....V/A	11 /	11 /	12 / 12	11 / 15
Brakes				
minimum friction material thickness				
Front.....mm	6.0 with backing	6.0 with backing	6.0 with backing	6.0 with backing
Rear.....mm	2.5 with backing	2.5	2.5	2.5 with backing
Tyres - Saloon / Hatch.....Size	185/60x15	—	—	175/70x13: 175/65x14
- Estate / Van.....Size	175/70x14	175/70x14	175/70x14	175/70x13: 175/65x14
Pressure - front / rear - Saloon / Hatch...bar	2.3 / 2.2	—	—	2.3 / 2.3
- Estate / Van.....bar	2.4 / 2.5	2.5 / 2.5	2.5 / 2.5	2.3 / 2.6
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.0 ± 1.0	[-0°10' ± 10']	[-0°10' ± 10']	-1.0 ± 1.0
Camber.....	-0°20' ± 30'	-0°20' ± 30'	-0°20' ± 30'	0° ± 30'
Castor.....	4° ± 30'	4° ± 30'	4° ± 30'	2° ± 30'
King pin inclination.....	—	13°21' ± 30'	13°21' ± 30'	11°40' ± 30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.25 ± 1.0	[0°50' ± 20']	[0°50' ± 20']	2.0 to 5.0
Camber.....	-1°15'	-1° ± 15'	-1° ± 15'	-20' ± 10'



RENAULT

	Megane 1.9 TDi (B/LA0NM5/2) 1999 to 2000	Scenic 1.9 TD (JAO) 1996	Scenic 1.9 TDi (JAO) 1997 to 1999	21 1.9 D (B/L/K/S48H) 1989 to 1995
Torque wrench settings				
Cylinder head - stage 1Nm	20 oiled	30 ¹ N	30 ¹ N	30 N
- stage 2Nm	+ 100°	+ 50°	+ 50°	+ 70°
- stage 3Nm	Wait 3 mins	Wait 3 mins, slacken	Wait 3 mins, slacken	Wait 3 mins
- stage 4Nm	Slacken	20 + 213°	20 + 213°	Slacken
- stage 5Nm	20	Warm up, allow to cool	Warm up, allow to cool	20
- stage 6Nm	+ 100° ¹	+ 120°	+ 120°	+ 123°
Big-end bearings.....Nm	10 + 43° N	50 N	50 N	45 to 50 N
Main bearings.....Nm	25 + 47°	65	65	60 to 65
Crankshaft pulley boltNm	20 + 115°	20 + 115°	20 + 115°	90 to 100
Camshaft pulley boltNm	60	—	—	50
Flywheel [driveplate] bolt.....Nm	50	50 to 55	50 to 55	50 to 55
Front hubsNm	250	250	250	250
Rear hubsNm	175	175	175	160
Wheel nuts / boltsNm	90	90	90	90
Glow plugsNm	25 to 30	22	22	15 to 30
Clutch pressure plate boltsNm	25	22.5	22.5	25
Injection pump sprocket.....Nm	—	65	90	50
Injectors.....Nm	27	70	—	65 to 75
Injection pump mounting boltsNm	—	20	—	—
Injector pipe unions.....Nm	—	25	—	25
Capacities				
Engine oil & filter.....litres	5.5	5.5	5.5	5.5
Gearbox.....litres	3.4	3.1	3.1	3.4
Automatic transmissionlitres	—	—	—	—
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	7.5	7.5	7.5	7.0
Fuel tank.....litres	60	60	60	66

Notes

Megane 1.9 TDi (B/LA0NM5/2) 1999 to 2000

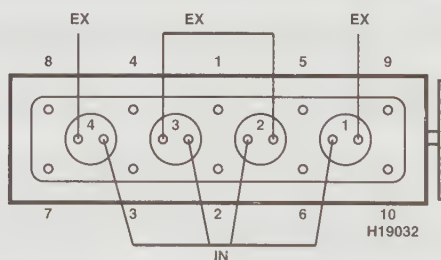
¹Apply procedure to each bolt in turn

Scenic 1.9 TD (JAO) 1996

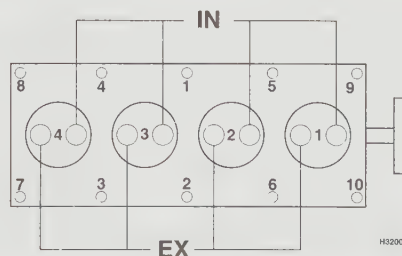
¹Apply procedure to each bolt in turn

Scenic 1.9 TDi (JAO) 1997 to 1999

¹Apply procedure to each bolt in turn



1870 cm³



1870 cm³ (TDi)

— Not applicable, or information not available



RENAULT

	21 2.1 D & 4x4 (B/L/K/S486) 1986 to 1995	21 2.1 D & 4x4 (B/L/K/S486) 1986 to 1995	21 2.1 TD (B/L/K488) 1986 to 1995	21 2.1 D (B/L/K/S48V) 1989 to 1995
Engine				
Engine type/code.....	J8S704 SOHC 54kW	J8S704 SOHC 54kW	J8S714 SOHC Turbo 65kW	J8S740 SOHC 54kW
Capacity (cm ³) / cylinders.....	2068 / 4	2068 / 4	2068 / 4	2068 / 4
Compression ration / pressurebar	21.5 / _	21.5 / _	21.5 / _	21.5 / _
Torque outputNm	0	0	185	0
Oil pressureidle [running] bar	0.8 [3.0 @ 3000]	0.8 [3.0 @ 3000]	0.8 [3.5 @ 3000]	0.8 [3.0 @ 3000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0.20	0.20	0.20	0.20
- exhaust (mm).....	0.25	0.25	0.25	0.25
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	89	89	89	89
Radiator cap pressurebar	1.2	1.2	1.2	1.2
Fuel system				
Idle speedrpm	825 ± 25	825 ± 25	825 ± 25	825 ± 25
Maximum (no load) speedrpm	4800 to 5100	4750 to 4900	4700 to 4800	5100 to 5300
Smoke test/opacityM ⁻¹ %	0.51	0.51	0.51	0.51
Static timing method.....	Plunger travel	Rotor lift	Plunger travel	Plunger travel
Timing dimension.....mm	0.7 ± 0.02	Dimension on pump	0.7 ± 0.02	0.75 ± 0.02
Crankshaft positionmm [°]	[0] TDC	[0] TDC	[0] TDC	[0] TDC
Turbo type / ref / pressurebar	-	-	Garrett 0.5 to 0.6 bar @ 2500	-
Injection pump make.....	Bosch	Roto Diesel	Bosch	Bosch
Injection pump part no.....	VE R158	DPC R8443 B402B	VE 4/9 R153	VE 4/9 R309
Injector Make / type.....	Bosch	Roto Diesel	Bosch	Bosch
Injector part no.....	DNOSD 189	RDN OSD 6751C	DNOSD 264	DNOSD 252+
Injection type.....	Indirect VE	Indirect DPC	Indirect VE	Indirect VE
Injection opening pressure, New [used]...bar	130 +8 -5	115 +7 -5	130 +8 -5	130 +8 -5
Glow plugs				
Maker.....	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type.....	0250 201 006 / CH137	0250 201 006 / CH137	0250 201 006 / CH137	0250 201 006 / CH137
Nominal rating.....V/A	11 / 12	11 / 12	11 / 15	11 / 15
Brakes				
minimum friction material thickness				
Front.....mm	6.5 with backing	6.5 with backing	6.5 with backing	6.5 with backing
Rear.....mm	2.5 with backing	2.5 with backing	2.5 with backing	2.5 with backing
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175/70x13: 175/65x14	175/70x13: 175/65x14	185/70x13: 185/65x14	175/70x13: 175/65x14
Pressure - front / rear - Saloon / Hatch...bar	2.3 / 2.3	2.3 / 2.3	2.3 / 2.3	2.3 / 2.3
- Estate / Vanbar	2.3 / 2.6	2.3 / 2.6	2.3 / 2.6	2.3 / 2.6
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-2.0 ± 1.0	-2.0 ± 1.0	-2.0 ± 1.0	-2.0 ± 1.0
Camber.....	-10' ± 30'	-10' ± 30'	-25' ± 30'	-10' ± 30'
Castor.....	2°30' ± 30'	2°30' ± 30'	2°30' ± 30'	2°30' ± 30'
King pin inclination.....	12°20' ± 30'	12°20' ± 30'	12°45' ± 30'	12°20' ± 30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 to 5.0'	2.0 to 5.0'	2.0 to 5.0	2.0 to 5.0
Camber.....	-40' ± 10' 89 ▶: -20' ± 10'²	-40' ± 10' 89 ▶: -20' ± 10'²	-40' ± 10'	-20' ± 10'



RENAULT

	21 2.1 D & 4x4 (B/L/K/S486) 1986 to 1995	21 2.1 D & 4x4 (B/L/K/S486) 1986 to 1995	21 2.1 TD (B/L/K488) 1986 to 1995	21 2.1 D (B/L/K/S48V) 1989 to 1995
Torque wrench settings				
Cylinder head - stage 1	Nm 30	30 N	30 N	30 N
- stage 2	Nm 50	50	50	50
- stage 3	Nm 95 to 105	95 to 105	95 to 105	95 to 105
- stage 4	Nm Warm up, allow to cool	Warm up, allow to cool	Warm up, allow to cool	Warm up, allow to cool
- stage 5	Nm Slacken, 95 to 105 ¹	Slacken, 95 to 105 ³	Slacken, 95 to 105 ¹	Slacken, 95 to 105 ¹
- stage 6	Nm -	-	-	-
Big-end bearings	Nm 65 N	65 N	65 N	65 N
Main bearings	Nm 88 to 98	88 to 98	88 to 98	88 to 98
Crankshaft pulley bolt	Nm 120 to 135	120 to 135	120 to 135	120 to 135
Camshaft pulley bolt	Nm 50	50	50	50
Flywheel [driveplate] bolt	Nm 55 to 60	55 to 60	55 to 60	55 to 60
Front hubs	Nm 250	250	250	250
Rear hubs	Nm 160 4x4: 210	160 4x4: 210	160	160 4x4: 210
Wheel nuts / bolts	Nm 90	90	90	90
Glow plugs	Nm 20 to 30	20 to 30	20 to 30	20 to 30
Clutch pressure plate bolts	Nm 25	25	25	25
Injection pump sprocket	Nm 50	50	50	50
Injectors	Nm 17	17	17	17
Injection pump mounting bolts	Nm -	-	-	-
Injector pipe unions	Nm 25	25	25	25
Capacities				
Engine oil & filter	litres 5.3	5.3	5.3	5.3
Gearbox	litres 2.2 4x4: 2.4	2.2 4x4: 2.4	2.2	2.2
Automatic transmission	litres -	-	-	-
Final drive	litres 4x4 rear: 1.3	4x4 rear: 1.3	WT	WT
Cooling system	litres 7.1	7.1	7.2	7.1
Fuel tank	litres 66 4x4: 62	66 4x4: 62	66	66

Notes

21 2.1 D & 4x4 (B/L/K/S486) 1986 to 1995

¹Each bolt in turn

¹4x4: 3.0 to 5.0

¹4x4: -30'±10'

21 2.1 D & 4x4 (B/L/K/S486) 1986 to 1995

¹Each bolt in turn

¹4x4: 3.0 to 5.0

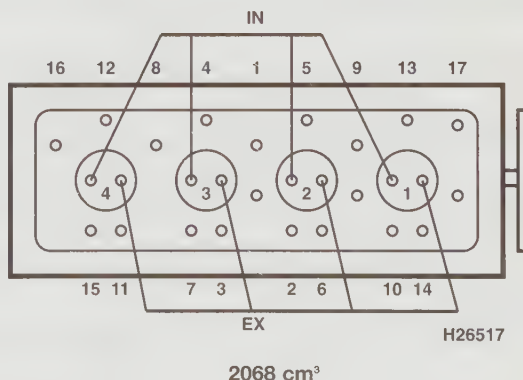
¹4x4: -30'±10'

21 2.1 TD (B/L/K488) 1986 to 1995

¹Each bolt in turn

21 2.1 D (B/L/K/S48V) 1989 to 1995

¹Each bolt in turn





RENAULT

	21 2.1 TD (B/L/K488) 1989 to 1995	21 2.1 TD (B/L/K487) 1991 to 1995	21 2.1 TD (B/L/K48A) 1992 to 1995	21 2.1 D (B/L/K480) 1992 to 1995
Engine				
Engine type/code	J8S742 SOHC Turbo 65kW	J8S786 SOHC Turbo 65kW	J8S604 SOHC Turbo 65kW	J8S784 SOHC 54kW
Capacity (cm ³) / cylinders	2068 / 4	2068 / 4	2068 / 4	2068 / 4
Compression ratio / pressure	21.5 / _	21.0 /	21.0 /	21.5 /
Torque output	185	185	185	0
Oil pressureidle [running] bar	0.8 [3.5 @ 3000]	0.8 [3.5 @ 3000]	0.8 [3.5 @ 3000]	0.8 [3.0 @ 3000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.20	0.20	0.20	0.20
- exhaust (mm)	0.25	0.25	0.25	0.25
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	89	81	81	81
Radiator cap pressurebar	1.2	1.2	1.2	1.2
Fuel system				
Idle speedrpm	825 ± 25	825 ± 25	825 ± 25	825 ± 25
Maximum (no load) speedrpm	4700 to 4800	4900	4900	5200
Smoke test/opacityM ⁻¹ %	0.51	2.3	0.51	0.51
Static timing method	Plunger travel	Dial gauge	Dial gauge	Dial gauge
Timing dimension.....mm	0.7 ± 0.02	0.7 ± 0.02	0.75 ± 0.02	0.75 ± 0.02
Crankshaft positionmm [°]	[0] TDC	0 TDC	0 TDC	0 TDC
Turbo type / ref / pressurebar	Garrett 0.5 to 0.6 bar @ 2500	Garrett	Garrett 0.7 to 0.8 bar @ 2500	-
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VE4/9 R345	VE R449/449-1	VE R423-2/3	VE R452/452-1
Injector Make / type	Bosch	Bosch	Bosch	Bosch
Injector part no.....	DNOSD 264	0432 217 237	0432 217 237	0432 217 259
Injection type.....	Indirect VE	Indirect VE	Indirect VE	Indirect VE
Injection opening pressure, New [used]...bar	130 +8 -5	145 to 158	145 to 158	125 to 138
Glow plugs				
Maker	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type	0250 201 006 / CH137	0250 201 006 / CH137	0250 201 006 / CH137	0250 201 006 / CH137
Nominal rating.....V/A	11 / 15	11 / 15	11 / 15	11 / 15
Brakes				
minimum friction material thickness				
Front.....mm	6.5 with backing	6.5 with backing	6.5 with backing	6.5 with backing
Rear.....mm	2.5 with backing	2.5 with backing	2.5 with backing	2.5 with backing
Tyres - Saloon / HatchSize				
- Estate / Van.....Size	185/70x13: 185/65x14	185/65x14	185/65x14	185/65x14
Pressure - front / rear - Saloon / Hatch...bar	2.3 / 2.3	2.3 / 2.3	2.3 / 2.3	2.3 / 2.3
- Estate / Vanbar	2.3 / 2.6	2.3 / 2.6	2.3 / 2.6	2.3 / 2.6
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-2.0 ± 1.0	1.0 ± 1.0	1.0 ± 1.0	1.0 ± 1.0
Camber	-25' ± 30'	WSM	WSM	WSM
Castor	2°30' ± 30'	WSM	WSM	WSM
King pin inclination.....	12°45' ± 30'	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 to 5.0	-2.0 to 5.0	-2.0 to 5.0	-2.0 to 5.0
Camber	-20' ± 10'	-0°20' ± 10'	-0°20' ± 10'	-0°20' ± 10'



RENAULT

	21 2.1 TD (B/L/K488) 1989 to 1995	21 2.1 TD (B/L/K487) 1991 to 1995	21 2.1 TD (B/L/K48A) 1992 to 1995	21 2.1 D (B/L/K480) 1992 to 1995
Torque wrench settings				
Cylinder head - stage 1Nm	30 N	30 N	30 N	30 N
- stage 2Nm	50	50	50	50
- stage 3Nm	95 to 105	95 to 105	95 to 105	95 to 105
- stage 4Nm	Warm up, allow to cool	Warm up, allow to cool	Warm up, allow to cool	Warm up, allow to cool
- stage 5Nm	Slacken, 95 to 105 ¹	Slacken, 95 to 105 ¹	Slacken, 95 to 105 ¹	Slacken, 95 to 105 ¹
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	65 N	65 N	65 N	65 N
Main bearings.....Nm	88 to 98	97	97	97
Crankshaft pulley boltNm	120 to 135	135	135	135
Camshaft pulley boltNm	50	50	50	50
Flywheel [driveplate] bolt.....Nm	55 to 60	60	60	60
Front hubsNm	250	250	250	250
Rear hubsNm	160	160	160	160
Wheel nuts / boltsNm	90	90 Alloy: 100	90 Alloy: 100	90 Alloy: 100
Glow plugsNm	20 to 30	30	30	30
Clutch pressure plate boltsNm	25	30	30	30
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	17	70	70	70
Injection pump mounting boltsNm	-	25	25	25
Injector pipe unionsNm	25	25	25	25
Capacities				
Engine oil & filter.....litres	5.3	5.2	5.2	5.2
Gearbox.....litres	2.2	2.2	2.2	2.2
Automatic transmissionlitres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	7.2	7.2	7.2	7.2
Fuel tank.....litres	66	66	66	66

Notes

21 2.1 TD (B/L/K488) 1989 to 1995

¹Each bolt in turn

21 2.1 TD (B/L/K487) 1991 to 1995

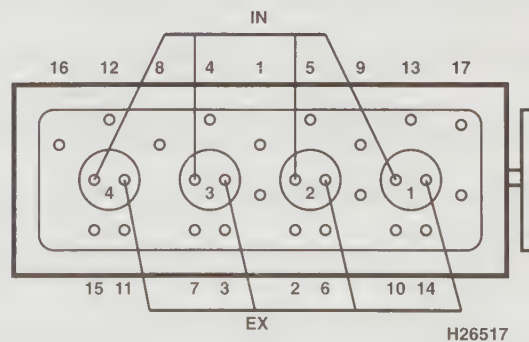
¹Each bolt in turn

21 2.1 TD (B/L/K48A) 1992 to 1995

¹Each bolt in turn

21 2.1 D (B/L/K480) 1992 to 1995

¹Each bolt in turn



2068 cm³



RENAULT

	21 2.1 D (B/L/K480) 1992 to 1995	Laguna 1.9 DTi (B/K/S56J) 1997 to 1999	Laguna 2.2 D 1995 to 1998	Laguna 2.2 DT B/K569 1996 to 1999
Engine				
Engine type/code.....	J8S600 SOHC 54kW	F9Q Turbo SOHC 74kW	G8T752/794 SOHC 12V 61kW	G8T760 SOHC Turbo 12V 85kW
Capacity (cm ³) / cylinders.....	2068 / 4	1870 / 4	2188 / 4	2188 / 4
Compression ratio / pressure.....bar	21.5 /	18.3 /	23.0 /	22.0 /
Torque output.....Nm	0	200	0	250
Oil pressure.....idle [running] bar	0.8 [3.0 @ 3000]	1.2 [3.5 @ 4000]	1.6 [4.0 @ 4000]	1.6 [4.0 @ 4000]
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0.20	0.20	0: Hyd.	0: Hyd.
- exhaust (mm).....	0.25	0.40	0: Hyd.	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature.....°C	81	82	82	82
Radiator cap pressure.....bar	1.2	1.2	1.2	1.2
Fuel system				
Idle speed.....rpm	825 ± 25	825 ± 25	725 ± 25	725 ± 25
Maximum (no load) speed.....rpm	5200	4800 ± 100	5200	5000 ± 100
Smoke test/opacity.....M ⁻¹ %	1.11	2.5	2.5	2.5
Static timing method.....	Dial gauge	Plunger travel	Rotor lift	Rotor lift
Timing dimension.....mm	0.75 ± 0.02	0.45	0.84	0.74
Crankshaft position.....mm [°]	0 TDC	0 TDC	0 TDC	0 TDC
Turbo type / ref / pressure.....bar	-	Garrett T2	Garrett	Garrett
Injection pump make.....	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VE R309-3/4	VE4/11E2000R6T2	VE4/9 R486	VE4/9F2250R593
Injector Make / type.....	Bosch	Bosch	Bosch	Bosch
Injector part no.....	0460 494 299	DLSA 145P619	DNOSD 313	DNOSD 313
Injection type.....	Indirect VE	Direct EDC	Indirect VE	-
Injection opening pressure, New [used]...bar	125 to 138	170 to 212	125 to 138	145 to 158
Glow plugs				
Maker.....	Bosch/Champion	Champion	Bosch	Bosch/Champion
Type.....	0250 201 006 / CH137	CH172	0250 202 025	0250 202 025 / CH169
Nominal rating.....V/A	11 / 15	11 /	11 / 15	11 / 15
Brakes				
minimum friction material thickness				
Front.....mm	6.5 with backing	6.0 with backing	6.0 with backing	6.0 with backing
Rear.....mm	2.5 with backing	2.5 with backing	6.0 with backing	6.0 with backing
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185/65x14	195/65x15	195/65x15	195/65x15
Pressure - front / rear - Saloon / Hatch...bar	2.3 / 2.3	2.5 / 2.3	2.5 / 2.3	2.5 / 2.3
- Estate / Van.....bar	2.3 / 2.6	2.5 / 2.6	2.5 / 2.6	2.5 / 2.6
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 ± 1.0	1.0 ± 1.0	1.0 ± 1.0	1.0 ± 1.0
Camber.....	WSM	WSM	WSM	WSM
Castor.....	WSM	WSM	WSM	WSM
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-2.0 to 5.0	3.0 ± 1.0	3.0 ± 1.0	3.0 ± 1.0
Camber.....	-0°20' ± 10'	-1°15' ± 10'	-1°15' ± 10'	-1°15' ± 10'



RENAULT

	21 2.1 D (B/L/K480) 1992 to 1995	Laguna 1.9 DTi (B/K/S56J) 1997 to 1999	Laguna 2.2 D 1995 to 1998	Laguna 2.2 DT B/K569 1996 to 1999
Torque wrench settings				
Cylinder head - stage 1.....Nm	30 N	20 oiled N	1	1
- stage 2.....Nm	50	+ 100° ± 6° wait 3 mins	-	-
- stage 3.....Nm	95 to 105	Slacken 20 + 100° ± 6° in turn	-	-
- stage 4.....Nm	Warm up, allow to cool	-	-	-
- stage 5.....Nm	Slacken, 95 to 105 ¹	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	65 N	10 + 43° N	20 + 70° N	20 + 70° N
Main bearings.....Nm	97	20 + 68° ± 6°	20 + 140°	20 + 140°
Crankshaft pulley bolt.....Nm	135	20 + 115°	25 + 65° N	25 + 65° N
Camshaft pulley bolt.....Nm	50	60	20 + 90° N	20 + 90° N
Flywheel [driveplate] bolt.....Nm	60	55	60 N	60 N
Front hubs.....Nm	250	250	250	250
Rear hubs.....Nm	160	190	175	175
Wheel nuts / bolts.....Nm	90 Alloy: 100	100	100	100
Glow plugs.....Nm	30	25 to 30	20	20
Clutch pressure plate bolts.....Nm	30	20	20	20
Injection pump sprocket.....Nm	50	-	90	90
Injectors.....Nm	70	27	70	70
Injection pump mounting bolts.....Nm	25	-	25	22
Injector pipe unions.....Nm	25	-	25	25
Capacities				
Engine oil & filter.....litres	5.2	4.6	7.2	7.2
Gearbox.....litres	2.2	3.1	2.8	2.8
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	7.2	7.5	9.0	9.0
Fuel tank.....litres	66	66	66	66

Notes

21 2.1 D (B/L/K480) 1992 to 1995

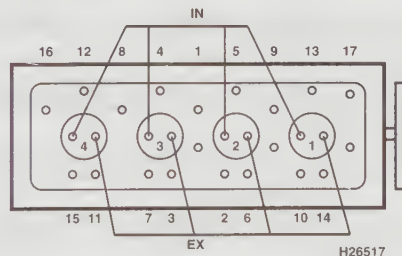
¹Each bolt in turn

Laguna 2.2 D 1995 to 1998

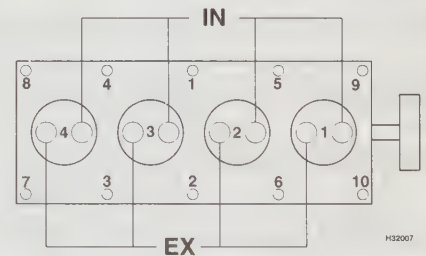
¹Engine number ≤183720: 35 + 70° ≥183721: 35 + 150°

Laguna 2.2 DT B/K569 1996 to 1999

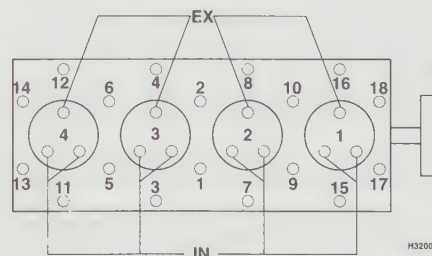
¹Engine number ≤183720: 35 + 70° ≥183721: 35 + 150°



2068 cm³



1870 cm³



2188 cm³

- Not applicable, or information not available



RENAULT

	25 TD (B290) 1984 to 1993	25 D (B296) 1989 to 1993	Safrane 2.1 TD (B546) 1991 to 1998	Safrane 2.5 TD (B548) 1995 to 1996
Engine				
Engine type/code.....	J8S708 SOHC Turbo 63kW	J8SC736 SOHC 50kW	J8S760 SOHC Turbo 66kW	S8U762/3 SOHC Turbo 83kW
Capacity (cm ³) / cylinders.....	2068 / 4	2068 / 4	2068 / 4	2499 / 4
Compression ratio / pressure.....bar	21.5 / _	21.5 / _	21.5 / _	22.5 / _
Torque outputNm	185	0	0	0
Oil pressureidle [running] bar	0.8 [3.5 @ 3000]	0.8 [3.0 @ 3000]	[3.5 @ 3000]	[3.5 @ 4100]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0.20	0.20	0.20	0.50
- exhaust (mm).....	0.25	0.25	0.25	0.50
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature°C	88	88	-	-
Radiator cap pressurebar	0.8 to 1.2	0.8 to 1.2	-	-
Fuel system				
Idle speedrpm	775 ± 50	800 ± 50	850 ± 25	850 ± 50
Maximum (no load) speedrpm	4700 to 4800	5100 to 5300	4700 to 4900	4950
Smoke test/opacityM ⁻¹ %	1.6	0.77	2.5	1.36
Static timing method.....	Plunger travel	Plunger travel	Dial gauge	Dial gauge
Timing dimension.....mm	0.7 ± 0.02	0.75 ± 0.02	0.75 ± 0.02	0.83 ± 0.04
Crankshaft positionmm [°]	[0] TDC	[0] TDC	0 TDC	0 TDC
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VE 4/9F R153/345	VE 4/9F R309	VE 4/9F R423	VE R442/4411
Injector Make / type.....	Bosch	Bosch	Bosch	Bosch
Injector part no.....	DNOSD 264	DNOSD 252+	DNOSD306	DNOSD307
Injection type.....	Indirect VE	Indirect VE	Indirect VE	Indirect VE
Injection opening pressure, New [used]...bar	130 +8 -5	130 +8 -5	150 to 158	140 to 153
Glow plugs				
Maker.....	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch
Type.....	0250 201 006 / CH137	0250 201 006 / CH137	0250 201 006 / CH137	0250 201 039
Nominal rating.....V/A	11 / 12	11 / 12	12 / 15	12 / 15
Brakes				
minimum friction material thickness				
Front.....mm	6.0 with backing	6.0 with backing	6.0 with backing	6.0 with backing
Rear.....mm	2.5 with backing ¹	2.5 with backing ¹	2.5 with backing	2.5 with backing
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/60x15	165x14: 185/70x14	195/60x15	195/60x15
Pressure - front / rear - Saloon / Hatch...bar	2.0 / 2.2	2.0 / 2.2	2.5 / 2.3	2.5 / 2.3
- Estate / Vanbar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-3.0 ± 1.0	-3.0 ± 1.0	1.0 ± 1.0	1.0 ± 1.0
Camber.....	0° ± 30'	0° ± 30'	WSM	WSM
Castor.....	2° PAS: 4°	2° PAS: 4°	WSM	WSM
King pin inclination.....	12°30' ± 30'	12°30' ± 30'	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 1.0°	0 ± 1.0°	2.0 ± 1.0	2.0 ± 1.0
Camber.....	-1°15' ± 30'	-1°15' ± 30'	-0°55'	-0°55'



RENAULT

	25 TD (B290) 1984 to 1993	25 D (B296) 1989 to 1993	Safrane 2.1 TD (B546) 1991 to 1998	Safrane 2.5 TD (B548) 1995 to 1996
Torque wrench settings				
Cylinder head - stage 1.....Nm	30 N	30 N	WSM	60 N
- stage 2.....Nm	50	50	-	60
- stage 3.....Nm	95 to 105	95 to 105	-	+ 180°
- stage 4.....Nm	Warm up, allow to cool	Warm up, allow to cool	-	-
- stage 5.....Nm	Slacken, 95 to 105 ³	Slacken, 95 to 105 ³	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	65 N	65 N	65 N	50 + 65° N
Main bearings.....Nm	88 to 98	88 to 98	98	160
Crankshaft pulley bolt.....Nm	120 to 135	120 to 135	135	200
Camshaft pulley bolt.....Nm	50	50	50	25
Flywheel [driveplate] bolt.....Nm	55 to 60	55 to 60	60	30 + 90°
Front hubs.....Nm	250	250	250	250
Rear hubs.....Nm	160	160	165	165
Wheel nuts / bolts.....Nm	100	90	90 Alloy: 100	90 Alloy: 100
Glow plugs.....Nm	20 to 30	20 to 30	20	-
Clutch pressure plate bolts.....Nm	25	25	20	-
Injection pump sprocket.....Nm	50	50	-	-
Injectors.....Nm	17	70	-	-
Injection pump mounting bolts.....Nm	-	-	-	-
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	6.0	6.0	6.7	5.5
Gearbox.....litres	2.0 86 ▶: 2.2	2.0	2.6	2.6
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	1.3	1.3
Cooling system.....litres	7.5	7.5	7.2	7.2
Fuel tank.....litres	67	67	80	80

Notes

25 TD (B290) 1984 to 1993

²Each bolt in turn

¹With ABS: 6.0 with backing

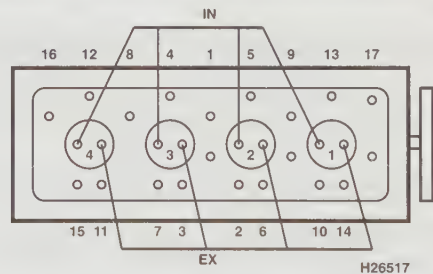
³1986 ▶: 1.0±1.0

25 D (B296) 1989 to 1993

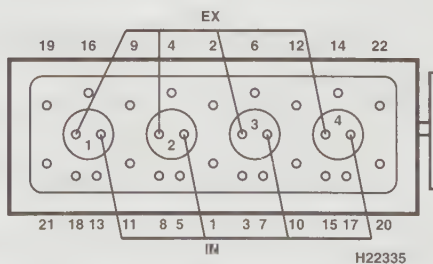
²Each bolt in turn

¹With ABS: 6.0 with backing

³1986 ▶: 1.0±1.0

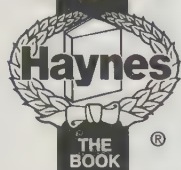


2068 cm³



2499 cm³

– Not applicable, or information not available



RENAULT

	Espace 2.1 TD (J115/S115) 1985 to 1991	Espace 2.1 TD (J637) 1991 to 1993	Espace 2.1 TD (J63D) 1991 to 1994	Espace 2.1 TD (J63G) 1991 to 1997
Engine				
Engine type/code	J8S240 SOHC Turbo 63kW	J8S772 SOHC Turbo 65kW	J8S610 SOHC Turbo 65kW	J8S776 SOHC Turbo 65kW
Capacity (cm ³) / cylinders	2068 / 4	2068 / 4	2068 / 4	2068 / 4
Compression ratio / pressure	21. / _	21.5 / _	21.5 / _	21.5 / _
Torque output	0	181	181	181
Oil pressure	0.8 [3.0 @ 3000]	0.8 [3.0 @ 3000]	0.8 [3.0 @ 3000]	0.8 [3.0 @ 3000]
Oil temperature	80	80	80	80
Valve clearances - inlet (mm)	0.20	0.20	0.20	0.20
- exhaust (mm)	0.25	0.25	0.25	0.25
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature	81	81	81	81
Radiator cap pressure	1.2	1.2	1.2	1.2
Fuel system				
Idle speed	700 to 750	700 to 750	700 to 750	700 to 750
Maximum (no load) speed	4700 to 4800	5000	5000	4800
Smoke test/opacity	1.6	2.46	2.46	2.46
Static timing method	Plunger travel	Dial gauge	Dial gauge	Dial gauge
Timing dimension	0.7 ± 0.02	0.7 ± 0.02	0.75 ± 0.02	0.7 ± 0.02
Crankshaft position	[0] TDC	[0] TDC	[0] TDC	[0] TDC
Turbo type / ref / pressure	0.6 bar @ 2500 rpm	0.6 bar @ 2500 rpm	0.6 bar @ 2500 rpm	0.6 bar @ 2500 rpm
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.	VE 4/9F R69	VE 4/9F R345	VE 4/9F R423-2	VE 4/9F R153
Injector Make / type	Bosch	Bosch	Bosch	Bosch
Injector part no.	DNOSD 193	0431 211 995	DNOSD306	DNOSD264
Injection type	Indirect VE	Indirect VE	Indirect VE	Indirect VE
Injection opening pressure, New [used]...bar	130 to 138	125 to 138	145 to 158	130 to 138
Glow plugs				
Maker	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type	0250 201 006 / CH137	0250 201 006 / CH137	0250 201 006 / CH137	0250 201 006 / CH137
Nominal rating	11 / 12	11 / 12	11 / 12	11 / 12
Brakes				
minimum friction material thickness				
Front	6.0 with backing	6.0 with backing	6.0 with backing	6.0 with backing
Rear	2.5 with backing	2.5 with backing	2.5 with backing	2.5 with backing
Tyres - Saloon / Hatch	-	-	-	-
- Estate / Van	185/70x13: 185/65x14	185/70x13: 185/65x14	185/70x13: 185/65x14	185/70x13: 185/65x14
Pressure - front / rear - Saloon / Hatch ...bar	-	-	-	-
- Estate / Van	2.4 / 2.1	2.4 / 2.1	2.4 / 2.1	2.4 / 2.1
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-)	-1.5 ± 0.5'	-1.9 to 2.6	-1.9 to 2.6	-1.9 to 2.6
Camber	20° ± 30'	-0°8' ± 30'	-0°8' ± 30'	-0°8' ± 30'
Castor	3° ± 30' [86 ▶: 3°25'±20']	4°24' ± 20'	4°24' ± 20'	4°24' ± 20'
King pin inclination	13° ± 30'	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-)	1.0 to 4.0	1.0 to 4.0	1.0 to 4.0	1.0 to 4.0
Camber	0° ± 30'	0° ± 30'	0° ± 30'	0° ± 30'



RENAULT

	Espace 2.1 TD (J115/S115) 1985 to 1991	Espace 2.1 TD (J637) 1991 to 1993	Espace 2.1 TD (J63D) 1991 to 1994	Espace 2.1 TD (J63G) 1991 to 1997
Torque wrench settings				
Cylinder head - stage 1Nm	30 N	30 N	30 N	30 N
- stage 2Nm	50	50	50	50
- stage 3Nm	Wait 3 mins, slacken	Wait 3 mins, slacken	Wait 3 mins, slacken	Wait 3 mins, slacken
- stage 4Nm	20°	20°	20°	20°
- stage 5Nm	—	—	—	—
- stage 6Nm	—	—	—	—
Big-end bearings.....Nm	65 N	65 N	65 N	65 N
Main bearings.....Nm	160	160	160	160
Crankshaft pulley bolt.....Nm	120 to 135	120 to 135	120 to 135	120 to 135
Camshaft pulley bolt.....Nm	50	50	50	50
Flywheel [driveplate] bolt.....Nm	55 to 60	55 to 60	55 to 60	55 to 60
Front hubs.....Nm	250	250	250	250
Rear hubs.....Nm	160	160	160	160
Wheel nuts / bolts.....Nm	90	90	90	90
Glow plugs.....Nm	20 to 30	20 to 30	20 to 30	20 to 30
Clutch pressure plate bolts.....Nm	25	25	25	25
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	17	17	17	17
Injection pump mounting bolts.....Nm	—	—	—	—
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	6.5	7.0	7.0	7.0
Gearbox.....litres	2.0	2.2	2.2	2.2
Automatic transmission.....litres	—	—	—	—
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	7.3	10.0	10.0	10.0
Fuel tank.....litres	65	65	65	65

Notes

Espace 2.1 TD (J115/S115) 1985 to 1991

²Bolts 1, 8 & 9: + 120°, + 120° Bolts 2, 3, 6, 7, 10, 11, 14 & 15: + 60°, + 60° Bolts 4, 5, 12 & 13: + 70°, + 70°
¹1986 ►: -4.0±2.0

Espace 2.1 TD (J637) 1991 to 1993

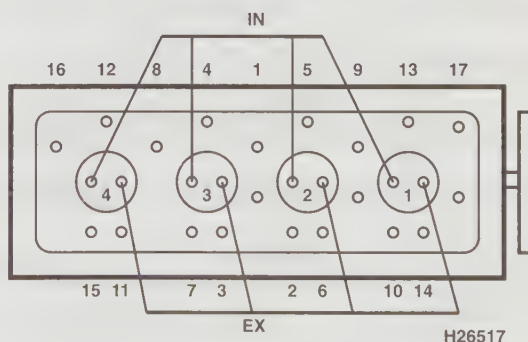
²Bolts 1, 8 & 9: + 120°, + 120° Bolts 2, 3, 6, 7, 10, 11, 14 & 15: + 60°, + 60° Bolts 4, 5, 12 & 13: + 70°, + 70°

Espace 2.1 TD (J63D) 1991 to 1994

²Bolts 1, 8 & 9: + 120°, + 120° Bolts 2, 3, 6, 7, 10, 11, 14 & 15: + 60°, + 60° Bolts 4, 5, 12 & 13: + 70°, + 70°

Espace 2.1 TD (J63G) 1991 to 1997

²Bolts 1, 8 & 9: + 120°, + 120° Bolts 2, 3, 6, 7, 10, 11, 14 & 15: + 60°, + 60° Bolts 4, 5, 12 & 13: + 70°, + 70°



2068 cm³



RENAULT

	Espace 2.1 TD (J633) 1992 to 1997	Espace 2.1 TD (J635E) 1995 to 1997	Espace 2.2 TD (JEOE) ¹ 1997 to 2000	Espace 2.2 TD (JEOH) ¹ 1997 to 2000
Engine				
Engine type/code.....	J8S778 SOHC Turbo 65kW	J8S612 SOHC Turbo 65kW	G8T716 SOHC 12V Turbo 85kW	G8T714 SOHC 12V Turbo 85kW
Capacity (cm ³) / cylinders.....	2068 / 4	2068 / 4	2188 / 4	2188 / 4
Compression ration / pressure.....bar	21.5 / _	21.5 / _	23.0 / _	23.0 / _
Torque output.....Nm	181	181	234	234
Oil pressure.....idle [running] bar	0.8 [3.0 @ 3000]	0.8 [3.0 @ 3000]	1.6 [4.0 @ 4000]	1.6 [4.0 @ 4000]
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0.20	0.20	0: Hyd.	0: Hyd.
- exhaust (mm).....	0.25	0.25	0: Hyd.	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature.....°C	81	81	89	89
Radiator cap pressure.....bar	1.2	1.2	1.6	1.6
Fuel system				
Idle speed.....rpm	800 ± 50	800 ± 50	725 ± 25	725 ± 25
Maximum (no load) speed.....rpm	5000	5000	5000	5000
Smoke test/opacity.....M ⁻¹ %	2.46	1.14	2.5	2.5
Static timing method.....	Dial gauge	Dial gauge	Rotor lift	Rotor lift
Timing dimension.....mm	0.75 ± 0.02	0.75 ± 0.02	0.74	0.6 ± 0.1
Crankshaft position.....mm [°]	[0] TDC	[0] TDC	TDC	TDC
Turbo type / ref / pressure.....bar	0.6 bar @ 2500 rpm	0.6 bar @ 2500 rpm	Garrett 0.9 bar @ 4300rpm	Garrett 0.9 bar @ 4300rpm
Injection pump make.....	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VER 484	VER 423	VE R593/4	VE R708
Injector Make / type.....	Bosch	Bosch	Bosch	Bosch
Injector part no.....	0432 217 237	DNOSD306	DNOSD313	DNOSD313
Injection type.....	Indirect VE	Indirect VE	Indirect VE	Indirect VE
Injection opening pressure, New [used]...bar	145 to 158	145 to 158	145 to 158	145 to 158
Glow plugs				
Maker.....	Bosch/Champion	Bosch/Champion	Champion	Champion
Type.....	0250 201 006 / CH137	0250 201 006 / CH137	CH169	CH169
Nominal rating.....V/A	11 / 12	11 / 12	11 /	11 /
Brakes				
minimum friction material thickness				
Front.....mm	6.0 with backing	6.0 with backing	6.0 with backing	6.0 with backing
Rear.....mm	2.5 with backing	2.5 with backing	2.5 with backing	2.5 with backing
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185/70x13: 185/65x14	185/70x13: 185/65x14	215/65x15	215/65x15
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Van.....bar	2.4 / 2.1	2.4 / 2.1	2.6 / 2.4	2.6 / 2.4
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.9 to 2.6	-1.9 to 2.6	[0° ± 10°]	[0° ± 10°]
Camber.....	-0°8' ± 30'	-0°8' ± 30'	WSM	WSM
Castor.....	4°24' ± 20'	4°24' ± 20'	WSM	WSM
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 to 4.0	1.0 to 4.0	[-30° ± 10°]	[-30° ± 10°]
Camber.....	0° ± 30'	0° ± 30'	-1°15' ± 10'	-1°15' ± 10'



RENAULT

	Espace 2.1 TD (J633) 1992 to 1997	Espace 2.1 TD (J635E) 1995 to 1997	Espace 2.2 TD (JEOE) ¹ 1997 to 2000	Espace 2.2 TD (JEOH) ¹ 1997 to 2000
Torque wrench settings				
Cylinder head - stage 1Nm	30 N	30 N	WSM	WSM
- stage 2Nm	50	50	-	-
- stage 3Nm	Wait 3 mins, slacken	Wait 3 mins, slacken	-	-
- stage 4Nm	20°	20°	-	-
- stage 5Nm	-	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearingsNm	65 N	65 N	20 + 70° N	20 + 70° N
Main bearingsNm	160	160	20 + 140°	20 + 140°
Crankshaft pulley boltNm	120 to 135	120 to 135	25 + 65° N	25 + 65° N
Camshaft pulley boltNm	50	50	20 + 90° N	20 + 90° N
Flywheel [driveplate] boltNm	55 to 60	55 to 60	60	60
Front hubsNm	250	250	280	280
Rear hubsNm	160	160	170	170
Wheel nuts / boltsNm	90	90	100	100
Glow plugsNm	20 to 30	20 to 30	25 to 30	25 to 30
Clutch pressure plate boltsNm	25	25	22.5	22.5
Injection pump sprocketNm	50	50	90	90
InjectorsNm	17	17	70	70
Injection pump mounting boltsNm	-	-	22	22
Injector pipe unionsNm	25	25	25	25
Capacities				
Engine oil & filterlitres	7.0	7.0	7.2	7.2
Gearboxlitres	2.2	2.2	2.8	2.8
Automatic transmissionlitres	-	-	-	-
Final drivelitres	WT	WT	WT	WT
Cooling systemlitres	10.0	10.0	9.0	9.0
Fuel tanklitres	65	65	80	80

Notes

Espace 2.1 TD (J633) 1992 to 1997

²Bolts 1, 8 & 9: + 120°; + 120° Bolts 2, 3, 6, 7, 10, 11, 14 & 15: + 60°; + 60° Bolts 4, 5, 12 & 13: + 70°; + 70°

Espace 2.1 TD (J635E) 1995 to 1997

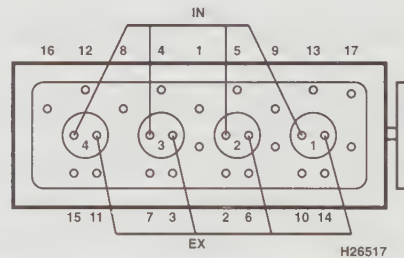
²Bolts 1, 8 & 9: + 120°; + 120° Bolts 2, 3, 6, 7, 10, 11, 14 & 15: + 60°; + 60° Bolts 4, 5, 12 & 13: + 70°; + 70°

Espace 2.2 TD (JEOE)¹ 1997 to 2000

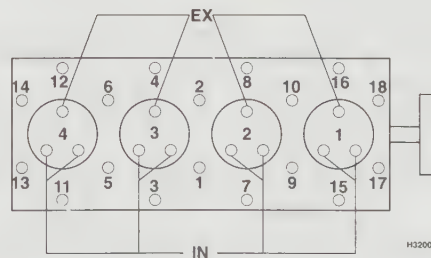
¹Grand Espace (JEO E/HL5)

Espace 2.2 TD (JEOH)¹ 1997 to 2000

¹Grand Espace (JEO E/HL5)

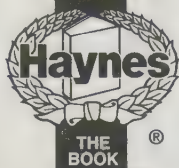


2068 cm³



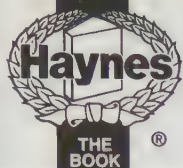
2188 cm³

- Not applicable, or information not available



RENAULT

	Kangoo 1.9D (F/KCOD/E) 1998 to 2000	Trafic 1.9 D (TxxJ) 1997 to 2000	Trafic 2.1 (T**3/V**3) 1987 to 1995	Trafic 2.1 1995 to 1999
Engine				
Engine type/code.....	F8Q662/630 SOHC 41kW	F8Q606 SOHC 45kW	852D750 SOHC 43kW	J8S758/620 SOHC 47kW
Capacity (cm ³) / cylinders.....	1870 / 4	1870 / 4	2068 / 4	2068 / 4
Compression ratio / pressure.....bar	21.5 / ≥20.0	21.5 / _	21.5 / 20.0	21.5 / 20.0
Torque output.....Nm	120	120	120	120
Oil pressure.....idle [running] bar	1.2 [3.5 @ 3000]	1.2 [3.5 @ 3000]	0.8 [3.5 @ 3000]	0.8 [3.5 @ 3000]
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0.20	0.10	0.20	0.20
- exhaust (mm).....	0.40	0.25	0.25	0.25
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	FE	FE	FE
Cooling system				
Thermostat opening temperature.....°C	82	89 to 101	83	83
Radiator cap pressure.....bar	1.2	1.2	0.8 to 1.2	0.8 to 1.2
Fuel system				
Idle speed.....rpm	825 ± 25	825 ± 50	750 ± 50	750 ± 50
Maximum (no load) speed.....rpm	4600 ± 100	4500 ± 100	4250 to 4400	4800
Smoke test/opacity.....M ⁻¹ %	2.5	2.5	1.11	2.5
Static timing method.....	-	Dial gauge	Rotor lift	Dial gauge
Timing dimension.....mm	-	Dimension on pump	Dimension on pump	0.75 ± 0.02
Crankshaft position.....mm [°]	-	TDC	[0] TDC	[0] TDC
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	Lucas	Lucas	Roto Diesel	Bosch
Injection pump part no.....	8448B171A/231A	8448B120A	DPC R8443140/1A	VER 452-2
Injector Make / type.....	-	CAV	Roto Diesel	Bosch
Injector part no.....	RDNOSDC6902	RDN OSDC 6902	RDN OSDC 6751	DNOSD302
Injection type.....	Indirect	8448B/120A or 110A	Indirect DPC	Indirect VER
Injection opening pressure, New [used]...bar	130 ± 5	130 ± 5	115 ± 5	125 to 138
Glow plugs				
Maker.....	Champion	Beru	Bosch/Champion	Champion
Type.....	CH155	-	0250 201 006 / CH88	CH137
Nominal rating.....V/A	-	-	11 / 12	11 /
Brakes				
minimum friction material thickness				
Front.....mm	6.5 with backing	9.0 with backing	9.0 with backing	9.0 with backing
Rear.....mm	2.0	5.0 with backing	5.0 with backing	5.0 with backing
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	165/70x13: 165/70x14	175x14	165x14: 175x14: 195x14	165x14: 175x14: 195x14
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Van.....bar	2.8 / 3.6: 2.4 / 3.0	3.3 / 3.8	Refer to owner's handbook	Refer to owner's handbook
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 ± 1.0	-1.0 ± 1.0	-1.0 ± 1.0	-1.0 ± 1.0
Camber.....	-15' ± 30'	0°30' ± 30'	1° ± 30'	1° ± 30'
Castor.....	3°25' ± 30'	3° ± 1°	1°30' ± 30'	1°30' ± 30'
King pin inclination.....	10°25' ± 30'	9° ± 30'	9° ± 30'	9° ± 30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.5 ± 1.0	0 to 3.0	0 to 3.0	0 to 3.0
Camber.....	-50' ± 15'	0° to 30'	0° to 30'	0° to 30'



RENAULT

	Kangoo 1.9D (F/KCOD/E) 1998 to 2000	Trafic 1.9 D (TxxJ) 1997 to 2000	Trafic 2.1 (T**3/V**3) 1987 to 1995	Trafic 2.1 1995 to 1999
Torque wrench settings				
Cylinder head - stage 1.....Nm	30	30	30	30 N
- stage 2.....Nm	+ 80° ± 4°	+ 80° ± 4°	50	50
- stage 3.....Nm	Slacken	Slacken	95 to 105	Slacken, 20
- stage 4.....Nm	25	25	95 to 105	³
- stage 5.....Nm	+ 213° ± 7°	+ 213° ± 7°	-	⁴
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	47 N	60 to 65 N	65 N	65 N
Main bearings.....Nm	62	88 to 98	88 to 98	88 to 98
Crankshaft pulley bolt.....Nm	120	20 + 115° ± 15°	120 to 135	120 to 135
Camshaft pulley bolt.....Nm	50	-	50	50
Flywheel [driveplate] bolt.....Nm	52	20 + 60°	55 to 60	55 to 60
Front hubs.....Nm	280	190 to 210	190 to 210	190 to 210
Rear hubs.....Nm	175	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	90	120	120	120
Glow plugs.....Nm	20	20	20 to 30	20 to 30
Clutch pressure plate bolts.....Nm	40	20	25	25
Injection pump sprocket.....Nm	65	20, then 45	50	50
Injectors.....Nm	70	70	17	17
Injection pump mounting bolts.....Nm	-	22	-	-
Injector pipe unions.....Nm	-	-	25	25
Capacities				
Engine oil & filter.....litres	5.2	5.5	6.0	6.0
Gearbox.....litres	3.4	1.8	2.5 NE3: 1.8 ¹	2.5 NE3: 1.8 ¹
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	1.3	0.8 ²	0.8 ²
Cooling system.....litres	7.4	6.8	8.0	8.0
Fuel tank.....litres	50	60	60 4x4: 70	60 4x4: 70

Notes

Trafic 2.1 (T**3/V**3) 1987 to 1995

¹4x4: 2.0

²NE3: 1.45. With cooler and 4x4: 1.3

Trafic 2.1 1995 to 1999

³Bolt 1: 105° Bolts: 2, 3, 6, 7, 10, 11, 14 & 15: + 60°

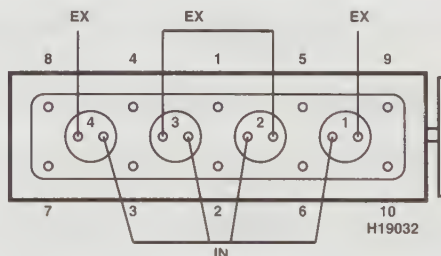
Bolts 4, 5, 12 & 13: + 70° Bolts 16 & 17: + 80°

⁴Bolt 1: 105° Bolts: 2, 3, 6, 7, 10, 11, 14 & 15: + 60°

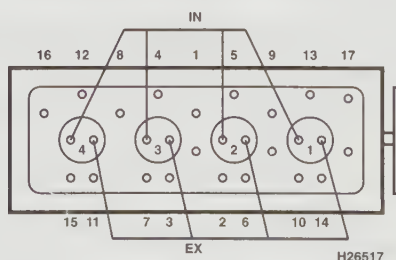
Bolts 4, 5, 12 & 13: + 70° Bolts 16 & 17: + 80°

¹4x4: 2.0

²NE3: 1.45. With cooler and 4x4: 1.3



1870 cm³



2068 cm³

- Not applicable, or information not available



RENAULT

	Trafic 2.5 (T**4/V**4) 1989 to 1995	Trafic 2.5 (T**B/V**B) 1989 to 1995	Trafic 2.5 (T**B/V**B) 1995 to 1999	Trafic 2.5 D (TxxG) 1997 to 2000
Engine				
Engine type/code.....	S8U750 8140 SOHC 50kW	S8U752 8140 SOHC 50kW	S8U758 SOHC 55kW	S8U782 SOHC 56kW
Capacity (cm ³) / cylinders.....	2499 / 4	2499 / 4	2499 / 4	2499 / 4
Compression ratio / pressure.....bar	22.0 / 20.0	22.0 / 20.0	23.0 / 20.0	23.0 / 20.0
Torque outputNm	162	162	158	158
Oil pressureidle [running] bar	1.2 [3.5 @ 4000]	1.2 [3.5 @ 4000]	1.2 [3.5 @ 4000]	1.2 [5.6 @ 4000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0.40	0.40	0.40	0.40
- exhaust (mm).....	0.40	0.40	0.40	0.40
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	FE
Cooling system				
Thermostat opening temperature°C	83	83	89	89 to 101
Radiator cap pressurebar	0.8 to 1.2	0.8 to 1.2	1.2	1.2
Fuel system				
Idle speedrpm	700 ± 50	700 ± 50	800 ± 50	800 ± 50
Maximum (no load) speedrpm	4600 to 4700	4600 to 4700	4750	4750 ± 100
Smoke test/opacityM ⁻¹ %	2.05	2.05	2.5	2.5
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Dial gauge
Timing dimension.....mm	1.1 ± 0.02	1.0 ± 0.02	1.0 ± 0.02	Dimension on pump
Crankshaft positionmm [°]	[0] TDC	[0] TDC	[0] TDC	TDC
Turbo type / ref / pressurebar	—	—	—	—
Injection pump make.....	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VE 4/9 R22-7	VE 4/9 R295-1	VE R589	VE4/10F2100R589
Injector Make / type.....	Bosch	Bosch	Bosch	Bosch
Injector part no.....	DNOSD 193	DNOSD 259	DNOSD 301	DN OSD 301
Injection type.....	Indirect VE	Indirect VE	Indirect VE	Indirect
Injection opening pressure, New [used]...bar	125 ± 5	125 ± 5	115 to 128	125 ± 5
Glow plugs				
Maker.....	Bosch/Champion	Bosch/Champion	Champion	Champion
Type.....	0250 201 006 / CH88	0250 201 006 / CH87	CH137	—
Nominal rating.....V/A	11 / 12	11 / 12	11 /	—
Brakes				
minimum friction material thickness				
Front.....mm	9.0 with backing	9.0 with backing	9.0 with backing	9.0 with backing
Rear.....mm	5.0 with backing	5.0 with backing	5.0 with backing	5.0 with backing
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	165x14: 175x14: 185x14: 195x14	165x14: 175x14: 185x14: 195x14	165x14: 175x14: 185x14: 195x14	185/70x14
Pressure - front / rear - Saloon / Hatch...bar	—	—	—	—
- Estate / Van.....bar	Refer to owner's handbook	Refer to owner's handbook	Refer to owner's handbook	4.1 / 4.5
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.0 ± 1.0	-1.0 ± 1.0	-1.0 ± 1.0	-1.0 ± 1.0
Camber.....	1° ± 30'	1° ± 30'	30' ± 1°	0°30' ± 30'
Castor.....	1°30' ± 30'	1°30' ± 30'	3° ± 1°	3° ± 1°
King pin inclination.....	9° ± 30'	9° ± 30'	9° ± 30'	9° ± 30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 to 3.0	0 to 3.0	-1.5 ± 1.5	0 to 3.0
Camber.....	0° to 30'	0° to 30'	15' ± 15'	0° to 30'



RENAULT

	Trafic 2.5 (T**4/V**4) 1989 to 1995	Trafic 2.5 (T**B/V**B) 1989 to 1995	Trafic 2.5 (T**B/V**B) 1995 to 1999	Trafic 2.5 D (TxxG) 1997 to 2000
Torque wrench settings				
Cylinder head - stage 1.....Nm	40 N	40 N	40 N	40 N
- stage 2.....Nm	40	40	40	40
- stage 3.....Nm	+ 180°	+ 180°	+ 180°	+ 180°
- stage 4.....Nm	-	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	110	110 N	110 N	50 + 60° N
Main bearings.....Nm	80, 160	80, 160	80, 160	80, 160
Crankshaft pulley bolt.....Nm	200	200	200	200
Camshaft pulley bolt.....Nm	25	25	25	-
Flywheel [driveplate] bolt.....Nm	120	50	30 + 90°	120
Front hubs.....Nm	190 to 210	190 to 210	250	190 to 210
Rear hubs.....Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	120	120	120	120
Glow plugs.....Nm	15	15	15	20
Clutch pressure plate bolts.....Nm	25	25	25	20
Injection pump sprocket.....Nm	50	50	50	20, 45
Injectors.....Nm	50	50	50	70
Injection pump mounting bolts.....Nm	50	50	50	22
Injector pipe unions.....Nm	25	25	25	-
Capacities				
Engine oil & filter.....litres	5.5	5.5	5.5	5.5
Gearbox.....litres	2.5 NE3: 1.8 ¹	2.5 NE3: 1.8 ¹	1.8	1.8
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	0.8 ²	0.8 ²	1.45	1.3
Cooling system.....litres	8.4	8.4	8.4	8.4
Fuel tank.....litres	60	60	60	60

Notes

Trafic 2.5 (T**4/V**4) 1989 to 1995

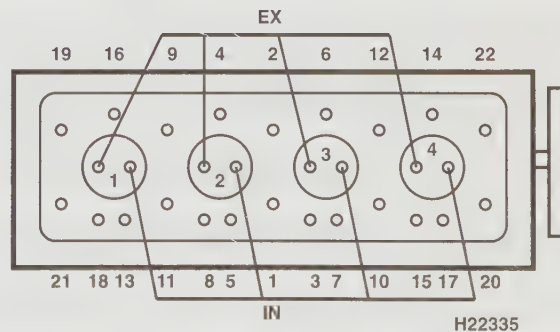
¹4x4: 2.0

²NE3: 1.45. With cooler and 4x4: 1.3

Trafic 2.5 (T**B/V**B) 1989 to 1995

¹4x4: 2.0

²NE3: 1.45. With cooler and 4x4: 1.3



- Not applicable, or information not available



RENAULT

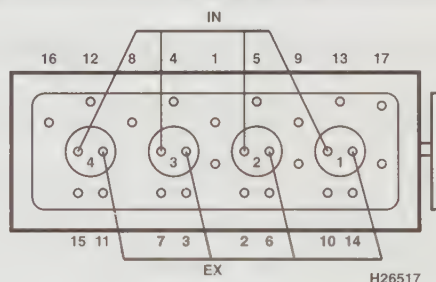
	Master 2.1 fwd (R**3) 1987 to 1995	Master 2.5 fwd (R**6) 1989 to 1995	Master 2.5 Turbo fwd (R**5) 1989 to 1995	Master 2.5 D 1995 to 1997
Engine				
Engine type/code.....	J8S330 SOHC 43kW	S8U 8140672510 SOHC 55kW	S9U 8140272500 Turbo 69kW	S8U748 SOHC 55kW
Capacity (cm ³) / cylinders.....	2068 / 4	2499 / 4	2499 / 4	2499 / 4
Compression ratio / pressure.....bar	21.5 / _	22.0 / _	17.5 / _	23.0 / _
Torque outputNm	0	166	209	158
Oil pressureidle [running] bar	0.8 [3.5 @ 3000]	0.8 [4.0 @ 4000]	0.8 [4.0 @ 4000]	0.8 [3.5 @ 4100]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0.20	0.50	0.50	0.50
- exhaust (mm).....	0.25	0.50	0.50	0.50
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	FE	TBE	TBE	FE
Cooling system				
Thermostat opening temperature°C	_	79	79	89
Radiator cap pressurebar	0.8 to 1.2	0.8	0.8	0.8 to 1.2
Fuel system				
Idle speedrpm	800 ± 50	700 ± 50	750 ± 50	770 ± 25
Maximum (no load) speedrpm	4400 to 4600	4600 to 4700	4100 to 4300	4850
Smoke test/opacityM ⁻¹ %	3.0	2.0	2.3	2.2
Static timing method.....	Rotor lift	Plunger travel	Plunger travel	Dial gauge
Timing dimension.....mm	Dimension on pump	1.1 ± 0.02	1.37 ± 0.02	1.0 ± 0.02
Crankshaft positionmm [°]	[0] TDC	[0] TDC	[0] TDC	[0] TDC
Turbo type / ref / pressure.....bar	_	_	_	_
Injection pump make.....	Roto Diesel	Bosch	Bosch	Bosch
Injection pump part no.....	_	VE 4/9F R22-7	VE 4/11 R368	VER 591
Injector Make / type.....	Roto Diesel	Bosch	Bosch	Bosch
Injector part no.....	RDN OSDC 6751	DNOSD 193	0432 193 876	DNOSD 301
Injection type.....	DPC R 8443 B 143B	Indirect VE	VE	Indirect VER
Injection opening pressure, New [used]...bar	115 ± 5	125 ± 5	225 ± 5	115 to 128
Glow plugs				
Maker.....	Champion	Champion	_	Bosch
Type.....	CH87	CH87	_	0250 201 006
Nominal rating.....V/A	_	_	_	_
Brakes				
minimum friction material thickness				
Front.....mm	9.0 with backing	9.0 with backing	9.0 with backing	9.0 with backing
Rear.....mm	3.0 with backing	3.0 with backing	3.0 with backing	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175x16: 195x16: 205x16: 215x16	205x16	205x16	195/70x15: 215/70x15
Pressure - front / rear - Saloon / Hatch...bar	_	_	_	_
- Estate / Van.....bar	Refer to owner's handbook	3.5 / 3.5	3.5 / 3.5	3.6 / 3.5: 3.5 / 3.75
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.2 ± 1.2	-1.2 ± 1.2	-1.2 ± 1.2	1.0 ± 1.0
Camber.....	1° ± 30'	1° ± 30'	1° ± 30'	0°1' ± 30'
Castor.....	3°30' ± 30'	3°30' ± 30'	3°30' ± 30'	2°58' ± 30'
King pin inclination.....	7°55' ± 30'	8° ± 30'	8° ± 30'	8° ± 30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.2 to -1.2	1.2 to -1.2	1.2 to -1.2	3.0 ± 2.0
Camber.....	0° to 30'	0° to 30'	0° to 30'	0°8' ± 05'



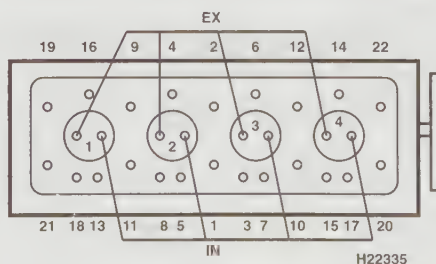
RENAULT

	Master 2.1 fwd (R**3) 1987 to 1995	Master 2.5 fwd (R**6) 1989 to 1995	Master 2.5 Turbo fwd (R**5) 1989 to 1995	Master 2.5 D 1995 to 1997
Torque wrench settings				
Cylinder head - stage 1.....Nm	30 N	40 N	40 N	40 N
- stage 2.....Nm	50	40	40	40
- stage 3.....Nm	95 to 105	+ 180°	+ 180°	+ 180°
- stage 4.....Nm	95 to 105	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	65 N	110 N	110 N	50 + 60° N
Main bearings.....Nm	88 to 98	80, 160	80, 160	80, 160
Crankshaft pulley bolt.....Nm	120 to 135	200	200	200
Camshaft pulley bolt.....Nm	50	25	25	25
Flywheel [driveplate] bolt.....Nm	55 to 60	120	120	120
Front hubs.....Nm	450	450	450	450
Rear hubs.....Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	160	160	160	160
Glow plugs.....Nm	20 to 30	15	15	15
Clutch pressure plate bolts.....Nm	25	25	25	25
Injection pump sprocket.....Nm	50	50	50	50
Injectors.....Nm	17	50	50	50
Injection pump mounting bolts.....Nm	-	50	50	-
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	6.0	5.5	6.0	7.0
Gearbox.....litres	4.0	4.0	4.0	4.0
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	14.0	14.0	14.0	11.0
Fuel tank.....litres	62	62	62	62

Notes

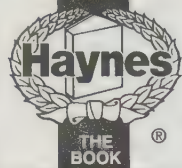


2068 cm³



2499 cm³

- Not applicable, or information not available



RENAULT

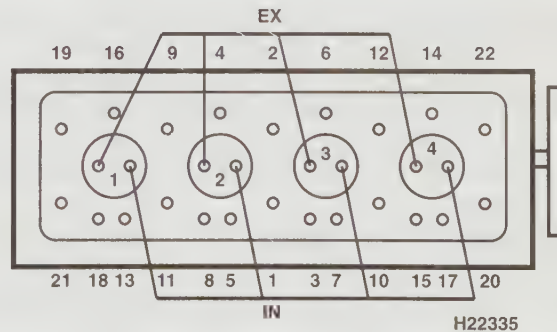
	Master 2.5 Turbo D 1995 to 1999	Master 2.5 D (F/UD0A) 1997 to 2000	Master 2.8 D (F/UD0C) 1997 to 2000	
Engine				
Engine type/code	S9U714 SOHC Turbo 69kW	S8U770 SOHC 59kW	S9W702 SOHC Turbo 85kW	
Capacity (cm ³) / cylinders	2499 / 4	2499 / 4	2799 / 4	
Compression ratio / pressure	18.5 / _	22.0 / _	19.1 /	
Torque output	158	155	260	
Oil pressureidle [running] bar	0.8 [3.5 @ 4100]	0.8 [3.5 @ 4100]	0.8 [4.0]	
Oil temperature	80	80	80	
Valve clearances - inlet (mm)	0.50	0.50	0.50	
- exhaust (mm)	0.50	0.50	0.50	
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	
No. 1 cylinder position	FE	FE	FE	
Cooling system				
Thermostat opening temperature	89	89	89	
Radiator cap pressure	0.8	0.8 to 1.2	0.8 to 1.2	
Fuel system				
Idle speed	750 ± 50	800 ± 25	800 ± 25	
Maximum (no load) speed	4500	4600 to 4700	4000 ± 100	
Smoke test/opacityM ⁻¹ %	1.14	3.0	2.5	
Static timing method	Dial gauge	Rotor lift	Plunger travel	
Timing dimension.....mm	1.2 ± 0.02	0.97 ± 0.02	1.1 ± 0.02	
Crankshaft positionmm [°]	[0] TDC	[0] TDC	[0] TDC	
Turbo type / ref / pressure	0.8 to 0.9 bar @ 2500rpm	-	-	
Injection pump make	Bosch	Bosch	Bosch	
Injection pump part no.....	VER 521	VE4/10F2100R227	VE4/12F1800R721	
Injector Make / type	Bosch	Bosch	Bosch	
Injector part no.....	DSLA 145P300	DNOSD 193	DNOSD 193	
Injection type.....	VER	Indirect VE	Direct VE	
Injection opening pressure, New [used]...bar	235 to 248	125 ± 5	235 to 243	
Glow plugs				
Maker	-	Champion	-	
Type	-	CH87	-	
Nominal rating	-	-	-	
Brakes				
minimum friction material thickness				
Front.....mm	9.0 with backing	9.0 with backing	9.0 with backing	
Rear.....mm	1.0	1.0	1.0	
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/70x15: 215/70x15	195/70x15: 215/70x15	195/70x15: 215/70x15	
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	
- Estate / Vanbar	3.6 / 3.5: 3.5 / 3.75	3.6 / 3.5: 3.5 / 3.75	3.6 / 3.75: 3.5 / 3.37	
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 ± 1.0	1.0 ± 1.0	1.0 ± 1.0	
Camber	0°1' ± 30'	0°1' ± 30'	-0°1' ± 30'	
Castor	2°58' ± 30'	2°58' ± 30'	2°58' ± 30'	
King pin inclination.....	8° ± 30'	8° ± 30'	8° ± 30'	
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	3.0 ± 2.0	-3.0 ± 2.0	-3.0 ± 2.0	
Camber	0°8' ± 05'	-14' ± 14'	-14' ± 14'	



RENAULT

	Master 2.5 Turbo D 1995 to 1999	Master 2.5 D (F/UD0A) 1997 to 2000	Master 2.8 D (F/UD0C) 1997 to 2000	
Torque wrench settings				
Cylinder head - stage 1	Nm 40 N	40 N	WSM	
- stage 2	Nm 40	40	-	
- stage 3	Nm + 180°	+ 180°	-	
- stage 4	Nm -	-	-	
- stage 5	Nm -	-	-	
- stage 6	Nm -	-	-	
Big-end bearings	Nm 110 N	50 + 60° N	50 + 60° N	
Main bearings	Nm 80, 160	80, 160	80, 160	
Crankshaft pulley bolt	Nm 200	200	200	
Camshaft pulley bolt	Nm 25	25	25	
Flywheel [driveplate] bolt	Nm 120	120	120	
Front hubs	Nm 450	450	450	
Rear hubs	Nm WSM	WSM	WSM	
Wheel nuts / bolts	Nm 160	160	160	
Glow plugs	Nm 15	15	15	
Clutch pressure plate bolts	Nm 25	25	25	
Injection pump sprocket	Nm 50	50	50	
Injectors	Nm 50	50	50	
Injection pump mounting bolts	Nm -	50	50	
Injector pipe unions	Nm 25	25	25	
Capacities				
Engine oil & filter	litres 6.0	7.0	6.7	
Gearbox	litres 4.0	4.0	4.0	
Automatic transmission	litres -	-	-	
Final drive	litres WT	WT	WT	
Cooling system	litres 11.0	11.0	11.0	
Fuel tank	litres 62	62	62	

Notes



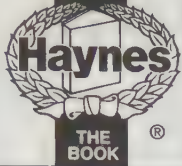
2499 cm³ / 2799 cm³

- Not applicable, or information not available



ROVER

	Metro/100 1.4 D 1992 to 1993	115 D 1995 to 1998	Maestro 500 & 700 Van 1986 to 1995	Maestro 2.0 1990 to 1992
Engine				
Engine type/code	TUD3 K9A SOHC 38kW	TUD5 VJZ SOHC 40kW	MDi SOHC 46kW	MDi SOHC 44kW
Capacity (cm ³) / cylinders	1360 / 4	1527 / 4	1994 / 4	1994 / 4
Compression ratio / pressure	22.0 /	23.0 /	18.1 /	18.1 / 20.7 to 34.5
Torque output	0	95	0	0
Oil pressureidle [running] bar	[4.0 @ 4000]	[4.0 @ 4000]	1.0 [4.2]	0.7 [3.8 @ 3000]
Oil temperature°C	80	80	—	80
Valve clearances - inlet (mm)	0.15	0.15 ± 0.08	0.25 to 0.35	0.25 to 0.35
- exhaust (mm)	0.30	0.30 ± 0.08	0.35 to 0.45	0.35 to 0.45
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	FE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	—	98	88	88
Radiator cap pressure	—	1.4	1.04	1.04
Fuel system				
Idle speedrpm	775 ± 25	800 ± 25	925 ± 25	800 to 850
Maximum (no load) speedrpm	5450	5450	5130	5130
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.35	2.5
Static timing method	Dial gauge	Refer to wsm	Plunger travel	Plunger travel
Timing dimension	Dimension on pump	—	1.37	1.1
Crankshaft positionmm [°]	0 TDC	—	0 TDC	0 TDC
Turbo type / ref / pressure	—	—	—	—
Injection pump make	Lucas	Lucas	Bosch	Bosch
Injection pump part no	DPC R844	DPC 070	0460 414 029	0460 414 029
Injector Make / type	CAV	CAV	4 hole	CAV
Injector part no	RDNOSDC 68863C	RDN125DC 6849	JB6801061	TRB 6704201
Injection type	Indirect DPC	Indirect DPC	Direct EPVE	Direct EPVE
Injection opening pressure, New [used]...bar	125 ± 5	135	222 [200]	228
Glow plugs				
Maker	Bosch/Champion	Bosch	Bosch/Champion	Bosch/Champion
Type	0250 202 001 / CH147	0250 202 020	0250 201 005 / CH68	0250 201 005 / CH68
Nominal rating	—	—	11 / 12	11 / 12
Brakes				
minimum friction material thickness				
Front	1.0	1.0	3.0	3.0
Rear	1.5	1.5	1.6	1.5
Tyres - Saloon / Hatch Size	155/65x13	155/65x13	—	175/70x14
- Estate / VanSize	—	—	165x13	—
Pressure - front / rear - Saloon / Hatch...bar	2.3 / 2.3	2.3 / 2.3	—	2.1 / 2.1
- Estate / Vanbar	—	—	2.0 / 2.8'	—
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-)	[0 to -25']	[0 to -25']	[0° ± 8']	[0° ± 8']
Camber	18' ± 37'	18' ± 37'	A: -15'±21' B: 30'±21''	A: -15'±21' B: 30'±21''
Castor	23' ± 55'	23' ± 55'	37' ± 30'	37' ± 30'
King pin inclination	10°52'	10°52'	A: 12°30'±30' B: 12°33'±30''	A: 12°30'±30' B: 12°33'±30''
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-)	[10' to 50']	[10' to 50']	[30' to 1°]	[30' to 1°]
Camber	-1° ± 30'	-1° ± 30'	-0.5° ± 0.5°	-0.5° ± 0.5°



ROVER

Metro/100 1.4 D
1992 to 1993

115 D
1995 to 1998

Maestro 500 & 700 Van
1986 to 1995

Maestro 2.0
1990 to 1992

Torque wrench settings

Cylinder head - stage 1.....Nm	60 ¹	40 N	50 N	50 N
- stage 2.....Nm	Slacken	+ 260°	100	100
- stage 3.....Nm	20	-	+ 90°	+ 90°
- stage 4.....Nm	+ 160°	-	-	-
- stage 5.....Nm	+ 160°	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	40 N	40 N	47 N	47 N
Main bearings.....Nm	20 + 45°	20 + 45°	112 N	112 N
Crankshaft pulley bolt.....Nm	110	110	180	180
Camshaft pulley bolt.....Nm	80	80	85	85
Flywheel [driveplate] bolt.....Nm	65	65	65	65
Front hubs.....Nm	210	210	203	203
Rear hubs.....Nm	120	120	68	68
Wheel nuts / bolts.....Nm	70	70	72	72
Glow plugs.....Nm	22	22	20	20
Clutch pressure plate bolts.....Nm	15	23	23	23
Injection pump sprocket.....Nm	50	25	60	60
Injectors.....Nm	70	55	43	43
Injection pump mounting bolts.....Nm	23	20	-	-
Injector pipe unions.....Nm	20	20	22	22

Capacities

Engine oil & filter.....litres	3.5	4.75	5.25	5.25
Gearbox.....litres	2.0	2.0	2.0	2.0
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	-	6.7	7.5	7.5
Fuel tank.....litres	33	33	54	54

Notes

Metro/100 1.4 D 1992 to 1993

¹Bolt length below head: ≤185.9 mm

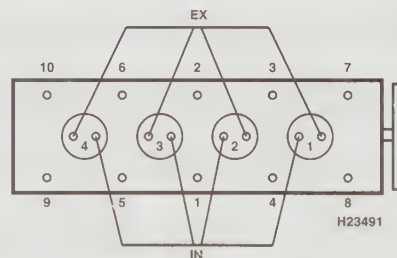
Maestro 500 & 700 Van 1986 to 1995

¹700 MODEL: 2.0 / 3.2

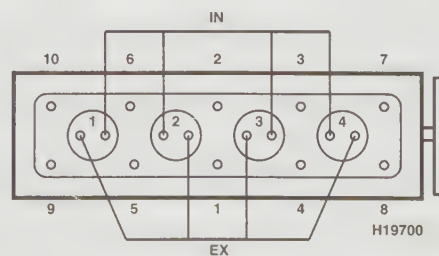
²A = early, B = later models

Maestro 2.0 1990 to 1992

¹A = early, B = later models



1360 cm³ / 1527 cm³



1994 cm³

- Not applicable, or information not available



ROVER

	Maestro 2.0 TD 1992 to 1995	Montego 2.0 TD 1991 to 1995	75 2.0 CDT 1999 to 2000	218, 418 TD 1991 to 1996
Engine				
Engine type/code.....	MDi SOHC Turbo 60kW	MDi SOHC Turbo 60kW	M47R DOHC 16V Turbo [†] 85kW	XUD7TE A8A SOHC Turbo 65kW
Capacity (cm ³) / cylinders.....	1994 / 4	1994 / 4	1950 / 4	1769 / 4
Compression ratio / pressure.....bar	17.2 / 34.0	17.2 / ≥34.0	18.0 /	22.0 / _
Torque output.....Nm	0	0	260	180
Oil pressure.....idle [running] bar	0.7 [4.2 @ 3000]	0.7 [4.2 @ 3000]	[3.0 to 4.5 @ 3500]	2.1
Oil temperature.....°C	80	-	80	-
Valve clearances - inlet (mm).....	0.25 to 0.35	0.25 to 0.35	0: Hyd.	0.15
- exhaust (mm).....	0.35 to 0.45	0.35 to 0.45	0: Hyd.	0.30
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TCE	FE
Cooling system				
Thermostat opening temperature.....°C	88	88	88 ± 2	88
Radiator cap pressure.....bar	1.04	1.04	1.43	1.4
Fuel system				
Idle speed.....rpm	800 to 850	825 ± 25	780 ± 50	800 ± 50
Maximum (no load) speed.....rpm	5130	5130	4900	4300 ± 160
Smoke test/opacity.....M ⁻¹ %	2.35	2.5	2.0	2.5
Static timing method.....	Plunger travel	Plunger travel	-	Dial gauge
Timing dimension.....mm	1.0	1.0	Computer controlled	Dimension on pump
Crankshaft position.....mm [°]	0 TDC	0 TDC	-	0 TDC
Turbo type / ref / pressure.....bar	-	-	Mitsubishi MR1 TD025L3 [‡]	-
Injection pump make.....	Bosch	Bosch	Bosch	CAV
Injection pump part no.....	-	11F2250R413	CP1	058
Injector Make / type.....	CAV	Bosch	Bosch	CAV
Injector part no.....	JB	DSL A 150PV3372 481	CRI 0445 110 030	RDN 12SDC 6862
Injection type.....	Direct EPVE	Direct EPVE	Direct Common Rail DDE 4.0	Indirect
Injection opening pressure, New [used]...bar	228	228	250 to 1350	130 ± 5
Glow plugs				
Maker.....	Bosch	Champion	-	Bosch/Champion
Type.....	0250 201 019	CH88 or CH137	-	0250 201 019 / CH88/137
Nominal rating.....V/A	11 / 12	11 / 12	-	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	3.0	3.0	8.8 with backing	3.0
Rear.....mm	1.5	1.5	8.0 with backing	2.0 Discs: 3.0
Tyres - Saloon / Hatch.....Size	175/70x14	180/65x365	195/65x15: 205/65x15:215/55x16	175/70x14
- Estate / Van.....Size	-	180/65x365	-	-
Pressure - front / rear - Saloon / Hatch...bar	2.1 / 2.1	2.0 / 2.0	2.2 / 2.1: 2.1 / 1.9:2.2 / 2.1	2.1 / 2.1
- Estate / Van.....bar	-	2.0 / 2.2	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 8']	[0° ± 8']	[0.17° ± 0.25°]	[-4' ± 8']
Camber.....	30' ± 21'	30' ± 21'	-0.33° ± 0.75°	-20' ± 10'
Castor.....	37' ± 30'	37' ± 30'	3.45° ± 1.0°	1°59' ± 30'
King pin inclination.....	12°33' ± 30'	12°33'	12.55° ± 0.5°	12°
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[30' to 1°]	[20' to 40']	[0.37° ± 0.25°]	[7' ± 4'] PW
Camber.....	-0.5° ± 0.5°	0° to -1°	-0.52° ± 0.75°	-25' ± 10'



ROVER

	Maestro 2.0 TD 1992 to 1995	Montego 2.0 TD 1991 to 1995	75 2.0 CDT 1999 to 2000	218, 418 TD 1991 to 1996
Torque wrench settings				
Cylinder head - stage 1	50 N	50 N	Bolts 1 to 11: 80 N	30
- stage 2	100	100	Slacken, 50	70
- stage 3	+ 90°	+ 90°	+ 90°	+ 120°
- stage 4	-	-	+ 90°	-
- stage 5	-	-	Bolt 12: 110	-
- stage 6	-	-	-	-
Big-end bearings	47 N	47 N	5, 25 + 70° N	50 N
Main bearings	112 N	112	20 + 70° N	20 + 70°
Crankshaft pulley bolt	180	180	100 + 60° + 60° + 30° N	40 + 60°
Camshaft pulley bolt	85	85	20 + 35°	40
Flywheel [driveplate] bolt	65	65	110 [115]	50
Front hubs	203	203	350	185
Rear hubs	68	68	210	185
Wheel nuts / bolts	72	72	125	100
Glow plugs	20	20	20	23
Clutch pressure plate bolts	23	23	25	25
Injection pump sprocket	60	60	65	50
Injectors	43	43	10	90
Injection pump mounting bolts	-	-	24	18
Injector pipe unions	22	22	20	20
Capacities				
Engine oil & filter	5.9	5.25	6.75	4.5
Gearbox	2.0	2.0	1.4	2.0
Automatic transmission	-	-	4.0	-
Final drive	WT	WT	WT	WT
Cooling system	7.5	7.5	8.2	8.0
Fuel tank	54	50	66	55

Notes

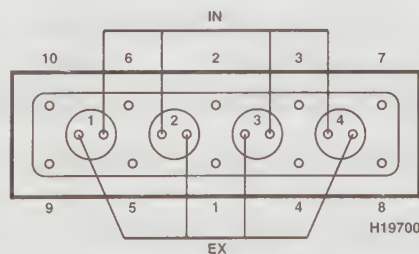
Montego 2.0 TD 1991 to 1995

*VIN 606579 ▶, RHD or 606709, LHD

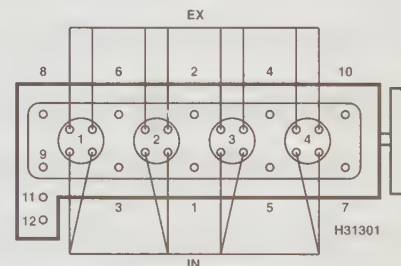
75 2.0 CDT 1999 to 2000

*Intercooled

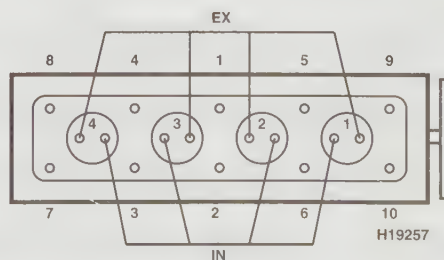
*1.4 to 1.8 bar



1994 cm³



1950 cm³



1769 cm³

- Not applicable, or information not available



ROVER

	218, 418 D 1991 to 1996	220 D/SD 1995 to 2000	220 Di/SDi 1995 to 2000	420 D/SD 1995 to 2000
Engine				
Engine type/code	XUD9A D9B SOHC 49kW	20T2R SOHC Turbo 63kW	20T2N ¹ SOHC Turbo 77kW	20T2R SOHC Turbo 63kW
Capacity (cm ³) / cylinders	1905 / 4	1994 / 4	1994 / 4	1994 / 4
Compression ratio / pressure	23.0 / _	19.5 /	19.5 /	19.5 /
Torque output	0	170	210	170
Oil pressureidle [running] bar	1.6	0.7 [3.8 @ 3000]	0.7 [3.8 @ 3000]	0.7
Oil temperature°C	_	80	80	80
Valve clearances - inlet (mm)	0.15	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0.30	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	FE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	88	82	82	82
Radiator cap pressurebar	1.4	0.9 to 1.2	0.9 to 1.2	0.9 to 1.2
Fuel system				
Idle speedrpm	800 ± 50	850 ± 50	850 ± 50	850 ± 50
Maximum (no load) speedrpm	4600 ± 160	_	_	_
Smoke test/opacityM ⁻¹ %	2.5	2.5	3.0	3.0
Static timing method.....	Dial gauge	Refer to wsm	Refer to wsm	Refer to wsm
Timing dimension.....mm	Dimension on pump	Electronic control	Electronic control	Electronic control
Crankshaft positionmm [°]	0 TDC	_	_	_
Turbo type / ref / pressurebar	_	_	_	_
Injection pump make	CAV	Bosch	Bosch	Bosch
Injection pump part no.....	057	VP21	VP37	VP21
Injector Make / type	CAV	Bosch	Bosch	Bosch
Injector part no.....	RDN 08D 6751	2 Stage MSC 100510	2 Stage MSC 100510	2 Stage MSC 100510
Injection type.....	Indirect	Direct Electronic	Direct VP37	Direct VP21
Injection opening pressure, New [used]...bar	125 ± 5	200 to 320	200 to 320	200 to 320
Glow plugs				
Maker	Bosch/Champion	Beru	Beru	Beru
Type	0250 201 019 / CH88/137	0100226 184	0100226 184	0100226 184
Nominal rating.....V/A	11 / 12	_	_	_
Brakes				
minimum friction material thickness				
Front.....mm	3.0	3.0	3.0	3.0
Rear.....mm	2.0 Discs: 3.0	2.0	2.0	2.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175/70x14	175/65x14	175/65x14	175/65x14
Pressure - front / rear - Saloon / Hatch...bar	2.1 / 2.1	2.4 / 2.1	2.4 / 2.1	2.4 / 2.1
- Estate / Vanbar	_	_	_	_
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[-4' ± 8']	[-0°5']	[-0°5']	[0° ± 12']
Camber	-20' ± 10'	0°20' ± 10'	0°20' ± 10'	0° ± 1°
Castor	1°59' ± 30'	2°30'	2°30'	1°28'
King pin inclination.....	12°	12°7' ± 30'	12°7' ± 30'	10°41'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[7' ± 4'] PW	[0°8' ± 10']	[0°8' ± 10']	[0°11' ± 10']
Camber	-25' ± 10'	-0°20' ± 10'	-0°20' ± 10'	-0°55' ± 10'



ROVER

	218, 418 D 1991 to 1996	220 D/SD 1995 to 2000	220 Di/SDi 1995 to 2000	420 D/SD 1995 to 2000
Torque wrench settings				
Cylinder head - stage 1.....Nm	30	30 ¹	30 ²	30 ¹
- stage 2.....Nm	70	65	65	65
- stage 3.....Nm	+ 120°	+ 90°	+ 90°	+ 90°
- stage 4.....Nm	-	+ 90°	+ 90°	+ 90°
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	50 N	48 N Bolts: 20 + 85° N	48 N Bolts: 20 + 85° N	48 N Bolts: 20 + 85° N
Main bearings.....Nm	20 + 70°	112	112	112
Crankshaft pulley bolt.....Nm	40 + 60°	63 + 90°	63 + 90°	63 + 90°
Camshaft pulley bolt.....Nm	40	20 + 90°	20 + 90°	20 + 90°
Flywheel [driveplate] bolt.....Nm	50	15 + 90° N	15 + 90° N	15 + 90° N
Front hubs.....Nm	185	180 N	180 N	180 N
Rear hubs.....Nm	185	185 N	185 N	185 N
Wheel nuts / bolts.....Nm	100	110	110	110
Glow plugs.....Nm	23	20	20	20
Clutch pressure plate bolts.....Nm	25	26	26	26
Injection pump sprocket.....Nm	50	-	20 + 90° N	20 + 90° N
Injectors.....Nm	90	-	25	25
Injection pump mounting bolts.....Nm	18	-	25	25
Injector pipe unions.....Nm	20	-	20	20
Capacities				
Engine oil & filter.....litres	4.5	4.9	4.9	4.0
Gearbox.....litres	2.0	2.0	2.0	2.2
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	8.0	7.0	7.0	7.0
Fuel tank.....litres	55	50	50	55

Notes

220 D/SD 1995 to 2000

¹Bolt length: ≤243.41 mm

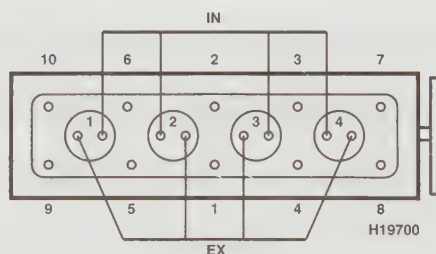
220 Di/SDi 1995 to 2000

¹With intercooler

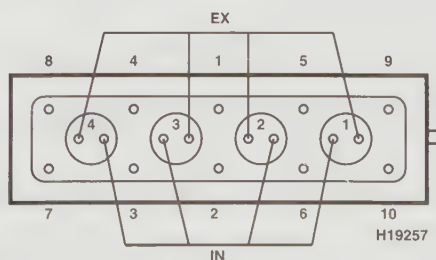
²Bolt length: ≤243.41 mm

420 D/SD 1995 to 2000

¹Bolt length: ≤243.41 mm



1994 cm³



1905 cm³

- Not applicable, or information not available



ROVER

	420 Di/SDi 1997 to 2000	620 Di 1997 to 2000	825 TD 1990 to 1991	825 TD 1991 to 1996
Engine				
Engine type/code	20T2N ¹ SOHC Turbo 77kW	20 T2N ¹ SOHC Turbo 77kW	VM 4924 SHIRG OHV Turbo 87kW	VM 425 SLIRR OHV Turbo 87kW
Capacity (cm ³) / cylinders	1994 / 4	1994 / 4	2498 / 4	2498 / 4
Compression ration / pressure	19.5 /	19.5 /	22.5 / ≥23.4	22.0 / 23.4
Torque output	210	210	268	268
Oil pressureidle [running] bar	0.7	0.7 [3.8 @ 3000]	[3.4 to 4.8]	[3.4 to 4.8 @ 4000]
Oil temperature°C	80	80	90 to 100	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0.30	0.30
- exhaust (mm)	0: Hyd.	0: Hyd.	0.30	0.30
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	-	-
Cooling system				
Thermostat opening temperature°C	82	82	80 ± 2	80
Radiator cap pressurebar	0.9 to 1.2	0.9 to 1.2	1.0	1.03
Fuel system				
Idle speedrpm	850 ± 50	850 ± 50	850 ± 50	900 ± 20
Maximum (no load) speedrpm	-	-	4700 to 4730	4730
Smoke test/opacityM ⁻¹ %	3.0	3.0	2.41	3.0
Static timing method	Refer to wsm	Refer to wsm	Plunger travel	Dial gauge
Timing dimension.....mm	Electronic control	Electronic control	0.68	0.68
Crankshaft positionmm [°]	-	-	0 TDC	0 TDC
Turbo type / ref / pressurebar	-	-	0.89 bar	0.89 bar
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VP37	VP37	VE4/10 F 2100 L269-2	VE4/10F
Injector Make / type	Bosch	Bosch	Bosch	Bosch
Injector part no.....	2 Stage MSC 100510	2 Stage MSC 100510	DNO SD 263 or SD 379	DNOSD301
Injection type.....	Direct VP21	Direct VP37	Indirect VE	Indirect VE
Injection opening pressure, New [used]...bar	200 to 320	200 to 320	150 to 158	150 to 158
Glow plugs				
Maker	Beru	Beru	Bosch/Champion	Bosch/Champion
Type	0100226 184	0100226 184	0250 201 012 / CH70	0250 201 033 / CH70
Nominal rating.....V/A	-	-	11 / 10.5	11 / 10.5
Brakes				
minimum friction material thickness				
Front.....mm	3.0	3.0	8.2 with backing	8.2 with backing
Rear.....mm	2.0	2.0	7.2 with backing	7.2 with backing
Tyres - Saloon / HatchSize				
- Estate / Van.....Size	185/65x14	195/65x15	195/65x15	195/65x15
Pressure - front / rear - Saloon / Hatch...bar	2.1 / 2.1	2.2 / 2.1	2.1 / 2.1	2.1 / 2.1
- Estate / Vanbar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 12']	0.0 ± 3.0	[0° ± 8'] 91 ▶: [0° ± 15']	[0° ± 15']
Camber	0° ± 1°	0° ± 1°	24' ± 1°12'	0°24' ± 1°12'
Castor	1°28'	3° ± 1°	2°36' ± 2°	2°35' ± 2°
King pin inclination.....	10°41'	7°37' ± 1°	8° ± 1°12'	7°27' ± 1°12'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°11' ± 10']	2.0 ± 2.0	[22' ± 15']	[0°22' ± 15']
Camber	-0°45' ± 10'	-0°30' ± 10'	13' ± 1°12'	0°18' ± 1°12'



ROVER

	420 Di/SDi 1997 to 2000	620 Di 1997 to 2000	825 TD 1990 to 1991	825 TD 1991 to 1996
Torque wrench settings				
Cylinder head - stage 1Nm	30°	30°	30	Bolts 1 - 10: 30, 30 ¹
- stage 2Nm	65	65	+ 70°	Bolts 11 & 12: 80
- stage 3Nm	+ 90°	+ 90°	+ 70°	Warm up, allow to cool
- stage 4Nm	+ 90°	+ 90°	Bolts 11 & 12: 80	Bolts 1 - 10: slacken, 30°
- stage 5Nm	—	—	Warm up, allow to cool	Bolts 11 & 12: 90
- stage 6Nm	—	—	Bolts 1 to 10: + 30° ¹	—
Big-end bearings.....Nm	48 N Bolts: 20 + 85° N	48 N Bolts: 20 + 85° N	29 + 60° N	29 + 60° N
Main bearings.....Nm	112	112	42	42
Crankshaft pulley bolt.....Nm	63 + 90°	63 + 90°	177	177
Camshaft pulley bolt.....Nm	20 + 90°	20 + 90° N	—	—
Flywheel [driveplate] bolt.....Nm	15 + 90° N	15 + 90° N	108	20 + 60°
Front hubs.....Nm	180 N	250 N	290	415
Rear hubs.....Nm	185 N	185 N	245	245
Wheel nuts / bolts.....Nm	110	110	110	110
Glow plugs.....Nm	20	20	23	23
Clutch pressure plate bolts.....Nm	26	26	22	22
Injection pump sprocket.....Nm	20 + 90° N	20 + 90° N	88	88
Injectors.....Nm	25	25	27	70
Injection pump mounting bolts.....Nm	—	25	30	25
Injector pipe unions.....Nm	20	20	19	19
Capacities				
Engine oil & filter.....litres	4.0	4.9	6.4	6.4
Gearbox.....litres	2.0	2.2	2.0	2.0
Automatic transmission.....litres	—	—	—	—
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	7.0	7.0	7.0	7.0
Fuel tank.....litres	55	65	68	68

Notes

420 Di/SDi 1997 to 2000

¹With intercooler

²Bolt length: ≤243.41 mm

620 Di 1997 to 2000

¹With intercooler

²Bolt length: ≤243.41 mm

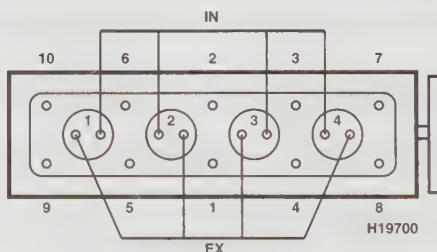
825 TD 1990 to 1991

¹Bolts 11 & 12: 90

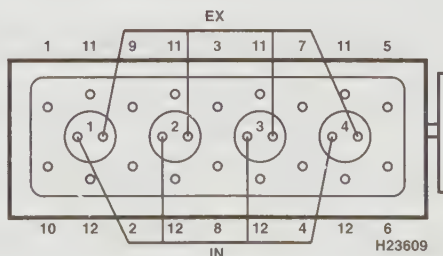
825 TD 1991 to 1996

¹+ 70°, + 70°

²+ 120°



1994 cm³



2498 cm³

— Not applicable, or information not available



ROVER

825 TD
1996 to 1997

Engine

Engine type/code.....	VM 425 SLIER OHV Turbo 89kW
Capacity (cm ³) / cylinders.....	2498 / 4
Compression ratio / pressure.....bar	24.5 / 23.4
Torque output.....Nm	268
Oil pressure.....idle [running] bar	[3.4 to 4.8 @ 4000]
Oil temperature.....°C	80
Valve clearances - inlet (mm).....	0.30
- exhaust (mm).....	0.30
Injection order.....	1-3-4-2
No. 1 cylinder position.....	-

Cooling system

Thermostat opening temperature.....°C	80
Radiator cap pressure.....bar	1.03

Fuel system

Idle speed.....rpm	887 ± 23
Maximum (no load) speed.....rpm	4700
Smoke test/opacity.....M ⁻¹ %	3.0
Static timing method.....	Dial gauge
Timing dimension.....mm	0.58 to 0.62
Crankshaft position.....mm [°]	0 TDC
Turbo type / ref / pressure.....bar	0.89 bar
Injection pump make.....	Bosch
Injection pump part no.....	VP36
Injector Make / type.....	Bosch
Injector part no.....	KCA 17S70
Injection type.....	Indirect VP36
Injection opening pressure, New [used]...bar	150 to 158

Glow plugs

Maker.....	Bosch
Type.....	0250 202 023
Nominal rating.....V/A	11 /

Brakes

minimum friction material thickness	
Front.....mm	8.2 with backing
Rear.....mm	7.2 with backing

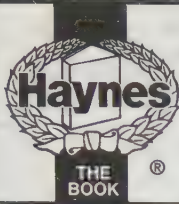
Tyres - Saloon / Hatch.....Size	195/65x15
- Estate / Van.....Size	-
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.1
- Estate / Van.....bar	-

Front suspension / wheel alignment

Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 15']
Camber.....	0°24' ± 1°12'
Castor.....	2°35' ± 2°
King pin inclination.....	7°27' ± 1°12'

Rear suspension / wheel alignment

Toe-in (+) / Toe-out (-).....mm [°]	[0°22' ± 15']
Camber.....	0°18' ± 1°12'



ROVER

825 TD
1996 to 1997

Torque wrench settings

Cylinder head - stage 1	Nm	Bolts 1 - 10: 30, 30 ¹
- stage 2	Nm	Bolts 11 & 12: 80
- stage 3	Nm	Warm up, allow to cool
- stage 4	Nm	Bolts 1 - 10: slacken, 30 ²
- stage 5	Nm	Bolts 11 & 12: 90
- stage 6	Nm	-
Big-end bearings	Nm	29 + 60° N
Main bearings	Nm	42
Crankshaft pulley bolt	Nm	177
Camshaft pulley bolt	Nm	-
Flywheel [driveplate] bolt	Nm	20 + 60° N
Front hubs	Nm	415
Rear hubs	Nm	245
Wheel nuts / bolts	Nm	110
Glow plugs	Nm	23
Clutch pressure plate bolts	Nm	22
Injection pump sprocket	Nm	88
Injectors	Nm	70
Injection pump mounting bolts	Nm	-
Injector pipe unions	Nm	19

Capacities

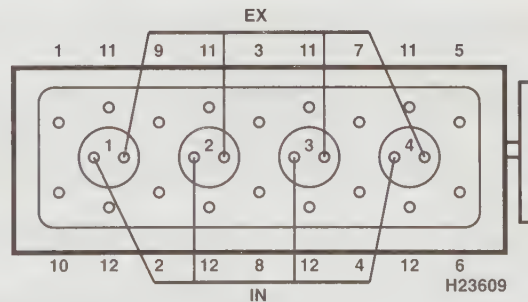
Engine oil & filter	litres	6.4
Gearbox	litres	2.0
Automatic transmission	litres	-
Final drive	litres	WT
Cooling system	litres	7.0
Fuel tank	litres	68

Notes

825 TD 1996 to 1997

¹+ 70°, + 70°

²+ 120°



2498 cm³

- Not applicable, or information not available



SEAT

	Arosa 1.7 D 1998 to 2000	Ibiza 1.7 D 1986 to 1992	Ibiza 1.7 D 1986 to 1992	Ibiza & Cordoba 1.9 D 1993 to 1995
Engine				
Engine type/code	AKU SOHC 44kW	022A5.000 SOHC 40kW	022A5.000 SOHC 40kW	1Y SOHC 47kW
Capacity (cm ³) / cylinders	1716 / 4	1714 / 4	1714 / 4	1896 / 4
Compression ratio / pressure	19.5 /	20.0 ± 0.5 / _	20.0 ± 0.5 / _	22.5 / ≥26.0
Torque output	115	0	0	124
Oil pressureidle [running] bar	≥2.0 @ 2000]	[3.4 to 4.9]	[3.4 to 4.9]	[2.0 @ 2000]
Oil temperature°C	80	100	100	80
Valve clearances - inlet (mm)	0: Hyd	0.35	0.35	0: Hyd.
- exhaust (mm)	0: Hyd	0.40	0.40	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	85	78 to 82	78 to 82	87
Radiator cap pressurebar	1.4 to 1.6	1.0	1.0	1.2 to 1.5
Fuel system				
Idle speedrpm	750 ± 50	750 to 800	750 to 800	900 ± 30
Maximum (no load) speedrpm	-	5040 to 5120	5040 to 5120	5200
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.0
Static timing method	-	Plunger travel	Dial gauge	Dial gauge
Timing dimension.....mm	Computer controlled	1.0 ± 0.05	1.0	0.9 ± 0.02
Crankshaft positionmm [°]	-	[0] TDC	[0] TDC	0 TDC
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make	-	Bosch	CAV	Bosch
Injection pump part no.....	-	-	DPS C8550A001A	VER 430
Injector Make / type	-	Bosch	CAV	Bosch
Injector part no.....	-	DNO SD 1930	CDN OSD 6827, DNC 5641032	0432 217 240
Injection type.....	Direct SDI	VE 4/9F 2300/R54	Indirect DPS	Indirect VER
Injection opening pressure, New [used]...bar	190 to 200	135 +8 -0	135 +8 -0	130 to 138 [120]
Glow plugs				
Maker	-	Bosch/Champion	Bosch/Champion	Bosch
Type	-	0250 200 068 / CH68	0250 200 068 / CH68	0250 201 032
Nominal rating.....V/A	-	11 / 12	11 / 12	11.5 / 8
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	1.5	1.5	7.0 with backing
Rear.....mm	2.5	1.5	1.5	2.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	155/70x13: 175/65x13:185/55x14	155x13: 165/65x14	155x13: 165/65x14	185/60x14
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.2: 2.1 / 2.1:2.1 / 2.1	1.9 / 1.8	1.9 / 1.8	2.2 / 1.9
- Estate / Vanbar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 10°]	2.0 to 6.0°	2.0 to 6.0°	[0° ± 10°]
Camber	1°20' ± 30'	30' to 1°30' ¹²	30' to 1°30' ¹²	-0°30' ± 30'
Castor	-	45' to 1°45' ¹³	45' to 1°45' ¹³	1°30' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[20' ± 10°]	2.0 to 6.0°	2.0 to 6.0°	[-0°15' ± 5°]
Camber	-1°20' ± 10°	15' to 1°15' ¹⁵	15' to 1°15' ¹⁵	-1°34' ± 20°



SEAT

	Arosa 1.7 D 1998 to 2000	Ibiza 1.7 D 1986 to 1992	Ibiza 1.7 D 1986 to 1992	Ibiza & Cordoba 1.9 D 1993 to 1995
Torque wrench settings				
Cylinder head - stage 1.....Nm	40 N	60	60	40 N
- stage 2.....Nm	60	+ 90°	+ 90°	60
- stage 3.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4.....Nm	+ 90°	-	-	+ 90°
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	30 + 90° N	74 N	74 N	30 + 90°
Main bearings.....Nm	65 + 90° N	113 M10: 80	113 M10: 80	65
Crankshaft pulley bolt.....Nm	90 + 90° N	145	145	90 + 90° N
Camshaft pulley bolt.....Nm	45	118	118	45
Flywheel [driveplate] bolt.....Nm	60 + 90° N	85	85	60 + 90° N
Front hubs.....Nm	200 -360°, 50 + 30°	216	216	265
Rear hubs.....Nm	WSM	216	216	WSM
Wheel nuts / bolts.....Nm	110	Alloy: 78 Steel: 86	Alloy: 78 Steel: 86	110
Glow plugs.....Nm	15	15	15	25
Clutch pressure plate bolts.....Nm	20	30	30	20
Injection pump sprocket.....Nm	55	49	49	45
Injectors.....Nm	-	39	39	70
Injection pump mounting bolts.....Nm	25	29	29	25
Injector pipe unions.....Nm	20	-	-	25
Capacities				
Engine oil & filter.....litres	4.7	5.0	5.0	4.5
Gearbox.....litres	2.7	3.4	3.4	2.0
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	6.5	8.0	8.0	6.5
Fuel tank.....litres	34	49	49	47

Notes

Ibiza 1.7 D 1986 to 1992

*1987 ▶: 1.0±2.0

*1987 ▶: -43'±30'

*1987 ▶: 0±30'

*1987 ▶: 4.0±2.0

*1987 ▶: 45'±30'

Ibiza 1.7 D 1986 to 1992

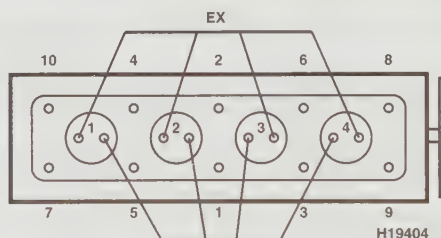
*1987 ▶: 1.0±2.0

*1987 ▶: -43'±30'

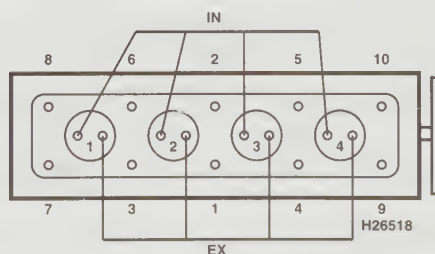
*1987 ▶: 0±30'

*1987 ▶: 4.0±2.0

*1987 ▶: 45'±30'



1716 cm³ / 1896 cm³



1714 cm³

- Not applicable, or information not available



SEAT

	Ibiza & Cordoba 1.9 TD 1994 to 1997	Ibiza & Cordoba 1.9 TDi 110 1998 to 2000	Ibiza & Cordoba 1.9 SDi 1997 to 2000	Ibiza & Cordoba 1.9 TDi 90 1997 to 2000
Engine				
Engine type/code	AAZ SOHC Turbo 55kW	AFN SOHC Turbo 81kW	AEY SOHC 47kW	1Z / AHU SOHC Turbo 66kW
Capacity (cm ³) / cylinders	1896 / 4	1896 / 4	1896 / 4	1896 / 4
Compression ratio / pressure	22.5 / ≥ 26.0	19.5 / ≥ 19	19.5 / ≥ 19	19.5 / ≥ 19
Torque output	150 Nm	235	125	202
Oil pressureidle [running] bar	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	87	87	87	87
Radiator cap pressurebar	1.2 to 1.5	1.4 to 1.6	1.4 to 1.6	1.4 to 1.6
Fuel system				
Idle speedrpm	920 ± 30	900 ± 30	900 ± 40	900 ± 30 N/A
Maximum (no load) speedrpm	5200	5200	5200 ± 100	5150
Smoke test/opacityM ⁻¹ %	2.0	2.0	2.5	3.0
Static timing method	Dial gauge	Refer to wsm	Refer to wsm	Refer to wsm
Timing dimension.....mm	0.8 ± 0.02	-	-	-
Crankshaft positionmm [°]	0 TDC	-	-	-
Turbo type / ref / pressurebar	-	0.5 to 0.65 bar @ 3500 rpm ¹	-	0.5 to 0.65 bar @ 4000 rpm ¹
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VER 433-3	VER 510	VE	VE
Injector Make / type	Bosch	-	Bosch	-
Injector part no.....	0432 217 244	-	-	-
Injection type.....	Indirect VER	Direct VER	DirectVE	Direct VE
Injection opening pressure, New [used]...bar	150 to 158 [140]	≥ 170	190 to 200 [170]	190 to 200 [170]
Glow plugs				
Maker	Bosch	Bosch	Bosch	Bosch
Type	0250 201 032	0250 202 009	0250 202 022	0250 202 009
Nominal rating.....V/A	11.5 / 8	11 / 12	11.5 / 12	11.5 / 12
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	2.0
Rear.....mm	2.5	2.5	2.5	2.0
Tyres - Saloon / HatchSize				
- Estate / Van.....Size	185/60x14	155x13	175/70x13	185/60x14
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 1.9	2.2 / 1.9	2.2 / 1.9	2.2 / 1.9
- Estate / Vanbar	-	-	-	2.2 / 2.0
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 10°]	[0° ± 10°]	[0° ± 10°]	[10° ± 20°]
Camber	-0°30' ± 30'	-30' ± 20'	-30' ± 20'	-30' ± 20'
Castor	1°30' ± 30'	1°33 ± 37'	1°33' ± 37'	1°33' ± 37'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[-0°15' ± 5°]	[20' ± 10°]	[20° ± 10°]	[20° ± 10°]
Camber	-1°34' ± 20'	-1°30' ± 30'	-1°30' ± 30'	-1°30' ± 30'



SEAT

	Ibiza & Cordoba 1.9 TD 1994 to 1997	Ibiza & Cordoba 1.9 TDi 110 1998 to 2000	Ibiza & Cordoba 1.9 SDi 1997 to 2000	Ibiza & Cordoba 1.9 TDi 90 1997 to 2000
Torque wrench settings				
Cylinder head - stage 1Nm	40 N	40 N	40 N	40 N
- stage 2Nm	60	60	60	60
- stage 3Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5Nm	—	—	—	—
- stage 6Nm	—	—	—	—
Big-end bearingsNm	30 + 90°	30 + 90° N	30 + 90° N	30 + 90° N
Main bearingsNm	65	65 + 90° N	65 + 90° N	65 + 90° N
Crankshaft pulley boltNm	90 + 90° N	90 + 90°	90 + 90° oiled N	90 + 90° N
Camshaft pulley boltNm	45	—	45	45
Flywheel [driveplate] boltNm	60 + 90° N	60 + 90° N	60 + 90° N	20
Front hubsNm	265	265	265	150 + 90° N
Rear hubsNm	WSM	—	—	200 N
Wheel nuts / boltsNm	110	110	110	140
Glow plugsNm	25	15	15	15
Clutch pressure plate boltsNm	20	—	20	20
Injection pump sprocketNm	45	55	55	55
InjectorsNm	70	20	20	20
Injection pump mounting boltsNm	25	—	—	25
Injector pipe unionsNm	25	25	25	25
Capacities				
Engine oil & filterlitres	4.5	4.5	4.3	4.7
Gearboxlitres	2.0	2.0	2.0	2.0
Automatic transmissionlitres	—	—	—	—
Final drivelitres	WT	WT	WT	WT
Cooling systemlitres	6.5	5.5	5.5	5.5
Fuel tanklitres	47	45	45	45

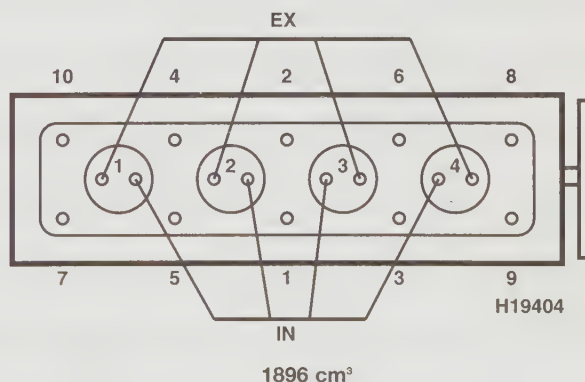
Notes

Ibiza & Cordoba 1.9 TDi 110 1998 to 2000

*Charge pressure control solenoid disconnected

Ibiza & Cordoba 1.9 TDi 90 1997 to 2000

*Charge pressure control solenoid disconnected





SEAT

	Malaga 1.7 D 1986 to 1992	Malaga 1.7 D 1986 to 1992	Toledo 1.9 D 1991 to 1998	Toledo 1.9 TD 1992 to 1998
Engine				
Engine type/code.....	022A5.000 SOHC 40kW	022A5.000 SOHC 40kW	1Y SOHC 8V 47kW	AAZ SOHC 8V Turbo 55kW
Capacity (cm ³) / cylinders.....	1714 / 4	1714 / 4	1896 / 4	1896 / 4
Compression ratio / pressure.....bar	20.0 ± 0.5 / _	20.0 ± 0.5 / _	22.5 / ≥26.0	22.5 / ≥26.0
Torque outputNm	0	0	124	150
Oil pressureidle [running] bar	[3.4 to 4.9]	[3.4 to 4.9]	[≥2.0 @ 2000]	[≥2.0]
Oil temperature°C	100	100	80	80
Valve clearances - inlet (mm).....	0.35	0.35	0: Hyd.	0: Hyd.
- exhaust (mm).....	0.40	0.40	0: Hyd.	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	78 to 82	78 to 82	85	85
Radiator cap pressurebar	1.0	1.0	1.4 to 1.6	1.4 to 1.6
Fuel system				
Idle speedrpm	750 to 800	750 to 800	900 ± 30	900 ± 30
Maximum (no load) speedrpm	5040 to 5120	5040 to 5120	5050 ± 50	5050 ± 50
Smoke test/opacityM ⁻¹ %	2.5	2.0	2.0	2.0
Static timing method.....	Plunger travel	Rotor groove	Dial gauge	Dial gauge
Timing dimension.....mm	1.0 ± 0.05	1.0	1.0 ± 0.02	0.9 ± 0.02
Crankshaft positionmm [°]	[0] TDC	[0] TDC	0 TDC	0 TDC
Turbo type / ref / pressure.....bar	-	-	-	0.6 to 0.83 bar @ 4000 rpm
Injection pump make.....	Bosch	CAV	Bosch	Bosch
Injection pump part no.....	-	DPS C8550A000A	VE4/8 R337	VE 4/9 R420
Injector Make / type.....	Bosch	CAV	Bosch	Bosch
Injector part no.....	DNO SD 1930	CDN OSD 6827, DNC 5641032	0432 217 206	0430 211 053
Injection type.....	VE 4/9F 2300/R54	Indirect DPS	Indirect VE	Indirect VE
Injection opening pressure, New [used]...bar	135 +8 -0	135 +8 -0	130 to 138 [120]	150 to 158 [140]
Glow plugs				
Maker.....	Champion	Champion	Bosch/Champion	Bosch/Champion
Type.....	CH68	CH68	0250 201 032 / CH160	0250 201 032 / CH160
Nominal rating.....V/A	11 / 12	11 / 12	11 / 12	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	1.5	1.5	7.0 with backing	7.0 with backing
Rear.....mm	1.5	1.5	2.5	2.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	155x13	155x13	175/70x13	175/70x13: 185/60x14
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	2.1 / 2.2	2.1 / 2.2	2.1 / 1.8	2.1 / 1.8
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-2.0 to 6.0'	-2.0 to 6.0'	0 ± 1.0	0 ± 1.0
Camber.....	30' to 1°30' ¹²	30' to 1°30' ¹²	-25' ± 20'	-25' ± 20'
Castor.....	45' to 1°45' ¹³	45' to 1°45' ¹³	1°40' ± 30'	1°40' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 to 6.0'	2.0 to 6.0'	[20' ± 10']	[20' ± 10']
Camber.....	15' to 1°15' ¹⁵	15' to 1°15' ¹⁵	-1°30' ± 10'	-1°30' ± 10'



SEAT

Malaga 1.7 D
 1986 to 1992

Malaga 1.7 D
 1986 to 1992

Toledo 1.9 D
 1991 to 1998

Toledo 1.9 TD
 1992 to 1998

Torque wrench settings

Cylinder head - stage 1	Nm 60	60	40 N	40 N
- stage 2	Nm + 90°	+ 90°	60	60
- stage 3	Nm + 90°	+ 90°	+ 90°	+ 90°
- stage 4	Nm -	-	+ 90°	+ 90°
- stage 5	Nm -	-	-	-
- stage 6	Nm -	-	-	-
Big-end bearings	Nm 74 N	74 N	30 + 90° N	30 + 90° N
Main bearings	Nm 113 M10: 80	113 M10: 80	65 + 90° N	65 + 90° N
Crankshaft pulley bolt	Nm 145	145	90 + 90° N	90 + 90° N
Camshaft pulley bolt	Nm 118	118	45	45
Flywheel [driveplate] bolt	Nm 85	85	20	20
Front hubs	Nm 216	216	260	260
Rear hubs	Nm 216	216	WSM	WSM
Wheel nuts / bolts	Nm Alloy: 78 Steel: 86	Alloy: 78 Steel: 86	110	110
Glow plugs	Nm 15	15	25	25
Clutch pressure plate bolts	Nm 30	30	60 + 90° N	60 + 90° N
Injection pump sprocket	Nm 49	49	55	55
Injectors	Nm 39	39	70	70
Injection pump mounting bolts	Nm 29	29	25	25
Injector pipe unions	Nm -	-	25	25

Capacities

Engine oil & filter	litres 5.0	5.0	4.3	4.3
Gearbox	litres 3.4	3.4	2.0	2.0
Automatic transmission	litres -	-	-	-
Final drive	litres WT	WT	WT	WT
Cooling system	litres 8.9	8.9	5.5	5.5
Fuel tank	litres 47	47	55	55

Notes
Malaga 1.7 D 1986 to 1992
¹1988 ▶: 1.0±2.0

²1988 ▶: -43'±30'

³1988 ▶: 0±30'

⁴1988 ▶: 4.0±2.0

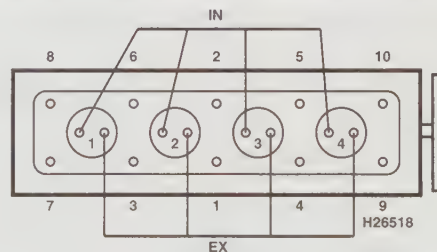
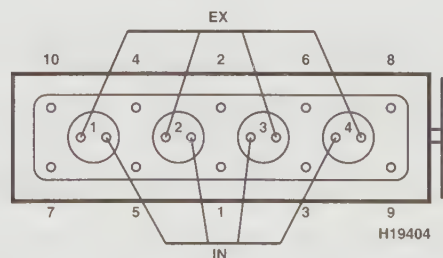
⁵1988 ▶: 45'±30'

Malaga 1.7 D 1986 to 1992
¹1988 ▶: 1.0±2.0

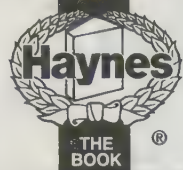
²1988 ▶: -43'±30'

³1988 ▶: 0±30'

⁴1988 ▶: 4.0±2.0

⁵1988 ▶: 45'±30'

 1714 cm³

 1896 cm³

- Not applicable, or information not available



	Toledo 1.9 TDi 1995 to 2000	Toledo 1.9 TDi 1995 to 2000	Alhambra 1.9 TDi 1996 to 2000	Alhambra 1.9 TDi 110 1997 to 2000
Engine				
Engine type/code.....	1Z / AHU SOHC Turbo 8V 66kW	AFN SOHC Turbo 8V 81kW	1Z / AHU SOHC Turbo 66kW	AFN SOHC Turbo 81kW
Capacity (cm ³) / cylinders.....	1896 / 4	1896 / 4	1896 / 4	1896 / 4
Compression ratio / pressurebar	19.5 / ≥19.0	19.5 / ≥19.0	19.5 / ≥19.0	19.5 /
Torque outputNm	202	235	202	234
Oil pressureidle [running] bar	[≥2.0 @ 2000]	[≥2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	85	87	85 to 105	85 to 105
Radiator cap pressurebar	1.4 to 1.6	1.4 to 1.6	1.4 to 1.6	1.4 to 1.6
Fuel system				
Idle speedrpm	900 ± 30	900 ± 30	900 ± 40	860 to 940 N/A
Maximum (no load) speedrpm	5050 ± 50	5050 ± 50	5200	-
Smoke test/opacityM ⁻¹ %	2.0	2.0	2.0	2.0
Static timing method.....	Refer to wsm	Refer to wsm	Refer to wsm	Refer to wsm
Timing dimension.....mm	-	-	-	-
Crankshaft positionmm [°]	-	-	-	-
Turbo type / ref / pressurebar	0.5 to 0.65 bar @ 4000	0.5 to 0.65 bar @ 3500 rpm ¹	0.5 to 0.65 bar @ 3500rpm ²	0.5 to 0.65 bar @ 3500 rpm ²
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VER 510	VER 510	VER 510	VER 510
Injector Make / type	Bosch	-	Bosch	-
Injector part no.....	-	-	0432 193 8383	-
Injection type.....	Direct VER	Direct VER	Direct VER	Direct VER
Injection opening pressure, New [used]...bar	190 to 200 [170]	190 to 200 [170]	190 to 200 [170]	190 to 200 [≥170]
Glow plugs				
Maker	Beru	Bosch	Bosch	Bosch
Type	855 MJ	0250 202 009	0250 202 009	0250 202 009
Nominal rating.....V/A	11.5 / 8	11 / 12	11.5 / 12	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	2.0	2.0
Rear.....mm	2.5	2.5	2.0	2.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	-	-	195/65x15;205/60x15;215/60x15	195/65x15;205/60x15;215/60x15
Pressure - front / rear - Saloon / Hatch...bar	2.1 / 1.8	2.1 / 1.8	-	-
- Estate / Vanbar	-	-	2.6 / 2.4; 2.7 / 2.5 ¹	2.6 / 2.4; 2.7 / 2.5 ¹
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 1.0	0 ± 1.0	[10' ± 20']	[10' ± 20']
Camber	-25' ± 20'	-25' ± 20'	-20' ± 45'	-20' ± 45'
Castor	1°40' ± 30'	1°40' ± 30'	3°20' ± 40'	3°20' ± 40'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[20' ± 10']	20' ± 10'	[10' ± 25'] (not Nivomat)	[10' ± 25'] (not Nivomat)
Camber	-1°30' ± 10'	-1°30' ± 10'	-20' ± 30' (not Nivomat)	-20' ± 30' (not Nivomat)



SEAT

Toledo 1.9 TDi
 1995 to 2000

Toledo 1.9 TDi
 1995 to 2000

Alhambra 1.9 TDi
 1996 to 2000

Alhambra 1.9 TDi 110
 1997 to 2000

Torque wrench settings

Cylinder head - stage 1.....Nm	40 N	40 N	40 N	40 N
- stage 2.....Nm	60	60	60	60
- stage 3.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	35 + 90° N	30 + 90° N	35 + 90° N	30 + 90° N
Main bearings.....Nm	65 + 90° N	65 + 90° N	65 + 90° N	65 + 90° N
Crankshaft pulley bolt.....Nm	90 + 90° N	90 + 90° N	90 + 90° N	90 + 90° N
Camshaft pulley bolt.....Nm	45	45	45	80
Flywheel [driveplate] bolt.....Nm	20	20	60 + 90° N	60 + 90° N
Front hubs.....Nm	260	260	150 + 90° N	150 + 90° N
Rear hubs.....Nm	WSM	WSM	200 N	200 N
Wheel nuts / bolts.....Nm	110	110	140	140
Glow plugs.....Nm	15	15	30	30
Clutch pressure plate bolts.....Nm	60 + 90° N	60 + 90° N	25	20
Injection pump sprocket.....Nm	55	55	55	55
Injectors.....Nm	70	-	-	-
Injection pump mounting bolts.....Nm	25	25	25	25
Injector pipe unions.....Nm	25	25	25	25

Capacities

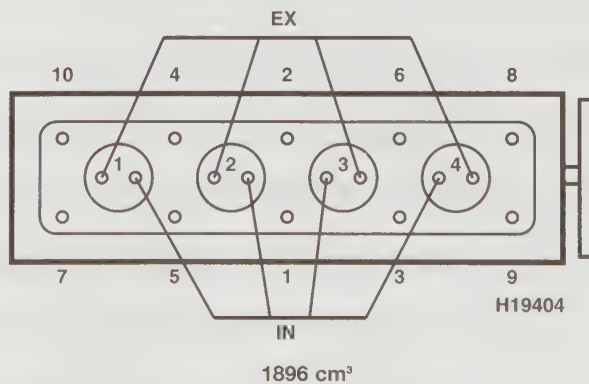
Engine oil & filter.....litres	4.3	4.3	4.7	4.3
Gearbox.....litres	2.0	2.0	2.2	2.2
Automatic transmission.....litres	-	-	3.5	3.5
Final drive.....litres	WT	WT	WT AT: 0.8	WT AT: 0.8
Cooling system.....litres	5.5	5.5	7.0 2 heat exchangers: 9.0	9.2
Fuel tank.....litres	55	55	70	70

Notes
Toledo 1.9 TDi 1995 to 2000
¹Charge pressure control solenoid disconnected

Alhambra 1.9 TDi 1996 to 2000
²15/60x15: 2.3 / 2.1

²Charge pressure control solenoid disconnected

Alhambra 1.9 TDi 110 1997 to 2000
²15/60x15: 2.3 / 2.1

²Charge pressure control solenoid disconnected


- Not applicable, or information not available



	Terra 1272 1990 to 1994	Inca 1.9 SDi 1998 to 2000	Inca 1.9 D 1998 to 2000	
Engine				
Engine type/code	MN SOHC 33kW	AEY SDI SOHC 47kW	1Y SOHC 47kW	
Capacity (cm ³) / cylinders	1272 / 4	1896 / 4	1896 / 4	
Compression ratio / pressure	22.0 / ≥25.0	19.5 / ≥19.0	22.5 / ≥26.0	
Torque outputNm	0	125	124	
Oil pressureidle [running] bar	[2.0]	[2.0 @ 2000]	[2.0 @ 2000]	
Oil temperature°C	80	-	80	
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	
No. 1 cylinder position	TBE	TBE	TBE	
Cooling system				
Thermostat opening temperature°C	87	92	87	
Radiator cap pressurebar	1.2 to 1.5	1.4 to 1.6	1.2 to 1.5	
Fuel system				
Idle speedrpm	900 ± 50	850 to 950	900 ± 30	
Maximum (no load) speedrpm	5400 ± 100	4950 to 5150	5150	
Smoke test/opacityM ⁻¹ %	2.0	2.0	2.0	
Static timing method	Plunger travel	Refer to wsm	Plunger travel	
Timing dimension.....mm	1.05 ± 0.02	-	0.9 ± 0.02	
Crankshaft positionmm [°]	[0] TDC	-	TDC	
Turbo type / ref / pressurebar	-	-	-	
Injection pump make	Bosch	Bosch	Lucas	
Injection pump part no.....	-	VE	-	
Injector Make / type	Bosch	Bosch	CAV	
Injector part no.....	-	-	-	
Injection type.....	Indirect	VE	Indirect	
Injection opening pressure, New [used]...bar	≥130 [120]	190 to 200 [170]	130 to 138 [≥120]	
Glow plugs				
Maker	Bosch/Champion	Bosch	Bosch/Champion	
Type	0250 201 021 / CH69	0250 202 022	0250 201 032 / CH160	
Nominal ratingV/A	11 / 12	11.5 / 12	11.5 / 8	
Brakes				
minimum friction material thickness				
Front.....mm	1.5	7.0 with backing	7.0 with backing	
Rear.....mm	1.5	2.5	2.5	
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	145x13	-	-	
Pressure - front / rear - Saloon / Hatch...bar	-	-	175/65x14	
- Estate / Vanbar	2.1 / 2.1	Refer to vehicle	2.2 / 2.4	
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 to -4.0	[0° ± 10']	[0° ± 10']	
Camber	1°30' ± 30'	-0°25' ± 20'	-1° ± 30'	
Castor	3° ± 30'	0°33' ± 30'	0°33' ± 30'	
King pin inclination.....	-	-	-	
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	[0°25' ± 20']	[0°25' ± 20']	
Camber	-	-1° ± 30'	-1° ± 30'	



SEAT

Terra 1272
1990 to 1994

Inca 1.9 SDi
1998 to 2000

Inca 1.9 D
1998 to 2000

Torque wrench settings

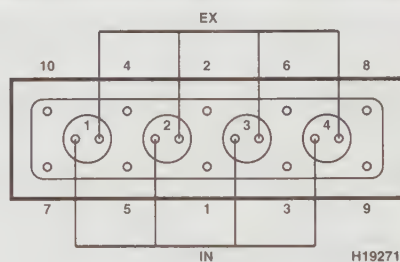
Cylinder head - stage 1	Nm	40 N	40 N	40 N
- stage 2	Nm	60	60	60
- stage 3	Nm	+ 180°	+ 90°	+ 90°
- stage 4	Nm	-	+ 90°	+ 90°
- stage 5	Nm	-	-	-
- stage 6	Nm	-	-	-
Big-end bearings	Nm	30 + 90° N	30 + 90° N	30 + 90° N
Main bearings	Nm	65	65 + 90° N	65
Crankshaft pulley bolt	Nm	90 + 180°	90 + 90° N	90 + 90° N
Camshaft pulley bolt ..	Nm	45	45	45
Flywheel [driveplate] bolt	Nm	30 + 90°	60 + 90°	30 + 90° N
Front hubs	Nm	196	265	265
Rear hubs	Nm	57	WSM	WSM
Wheel nuts / bolts	Nm	86	110	110
Glow plugs	Nm	30	25	30
Clutch pressure plate bolts	Nm	25	20	20
Injection pump sprocket	Nm	50	55	-
Injectors	Nm	70	20	70
Injection pump mounting bolts	Nm	25	25	-
Injector pipe unions	Nm	25	25	-

Capacities

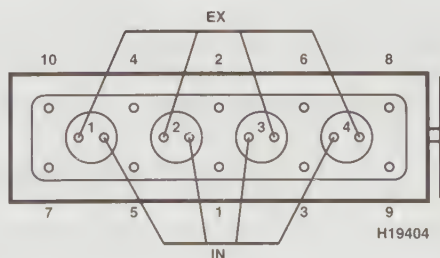
Engine oil & filter	litres	3.5	4.5	4.5
Gearbox	litres	2.4	2.0	2.0
Automatic transmission	litres	-	-	-
Final drive	litres	WT	WT	WT
Cooling system	litres	5.2	6.6	6.6
Fuel tank	litres	35	52	52

Notes

- Not applicable, or information not available



1272 cm³



1896 cm³



	Felicia 1.9 D 1997 to 2000	Octavia 1.9 SDi 1997 to 2000	Octavia 1.9 TDi 1998 to 2000	Octavia 1.9 TDi 1998 to 2000
Engine				
Engine type/code.....	AEF SOHC 47kW	AGP SOHC 50kW	AGR SOHC Turbo 64kW	AHF SOHC Turbo 81kW
Capacity (cm ³) / cylinders.....	1896 / 4	1896 / 4	1896 / 4	1896 / 4
Compression ration / pressure.....bar	22.5 / 26 to 34	19.5 / 25 to 31	19.5 / 19 to 31	19.5 / 19 to 31
Torque outputNm	124	130	202	235
Oil pressureidle [running] bar	[2.0 @ 2000]	1.0 [2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-2-4	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	84	87	85	87
Radiator cap pressurebar	1.4	1.2 to 1.5	1.3 to 1.5	1.2 to 1.5
Fuel system				
Idle speedrpm	940 ± 20	875 to 950	780 to 900 N/A	875 to 950
Maximum (no load) speedrpm	5050 ± 100	4950 to 5150	4800 to 5200	4800 to 5200
Smoke test/opacityM ⁻¹ %	1.05	2.0	2.5	2.5
Static timing method.....	Plunger travel	-	Refer to wsm	Refer to wsm
Timing dimension.....mm	0.9 ± 0.02	Computer controlled	Computer controlled	Computer controlled
Crankshaft positionmm [°]	TDC	-	-	-
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make	Lucas	Bosch	Bosch	Bosch
Injection pump part no.....	DPC	-	VP37	-
Injector Make / type	-	-	-	-
Injector part no.....	-	-	-	-
Injection type.....	Indirect DPC	Direct	Direct EDC VP37	Direct EDC
Injection opening pressure, New [used]...bar	130 to 138 [≥120]	190 to 200 [170]	190 to 200 [≥170]	190 to 200 [≥170]
Glow plugs				
Maker	Champion	-	Beru	Beru
Type	CH160	-	GN855	GN855
Nominal ratingV/A	11.5 / 8	-	-	-
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	2.5	2.5	2.2	2.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	165/70x13	-	195/65x15	195/65x15;205/60x15;205/55x16
Pressure - front / rear - Saloon / Hatch...bar	2.0 / 2.0	175/80x14; 195/65x15;205/60x15	195/65x15	195/65x15;205/60x15;205/55x16
- Estate / Vanbar	2.0 / 2.0	2.2 / 2.2	2.1 / 2.1	2.0 / 2.2
			Refer to vehicle	2.0 / 2.2
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 ± 1.0	[0° ± 10°]	[0° ± 10°]	0° ± 10°
Camber	-0°30' ± 30'	-30' ± 30'	-0°30' ± 30'	-30' ± 30'
Castor	1°20' ± 45'	7°40' ± 30'	7°40' ± 30'	7°40' ± 30'
King pin inclination.....	12°15' ± 50'	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[-1°10' ± 30°]	[20' ± 10°]	[0°20' ± 20°]	[20' ± 10°]
Camber	-	-1°27' ± 30'	-1°36' ± 10'	-1°27' ± 30'



SKODA

Felicia 1.9 D
1997 to 2000

Octavia 1.9 SDi
1997 to 2000

Octavia 1.9 TDi
1998 to 2000

Octavia 1.9 TDi
1998 to 2000

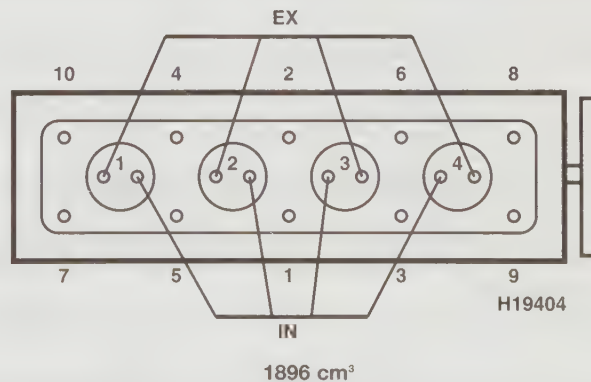
Torque wrench settings

Cylinder head - stage 1.....Nm	40 N	35 N	35 N	35 N
- stage 2.....Nm	60	60	60	60
- stage 3.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	30 + 90° N	30 + 90° N	30 + 90° N	30 + 90° N
Main bearings.....Nm	65 + 90° N	65 + 90° N	65 + 90° N	65 + 90° N
Crankshaft pulley bolt.....Nm	90 + 90° N	120 + 90° N	120 + 90° N	120 + 90° N
Camshaft pulley bolt.....Nm	4	45	45	45
Flywheel [driveplate] bolt.....Nm	65 + 90° N	60 + 90° N [60 + 90° N]	60 + 90° N	60 + 90° N
Front hubs.....Nm	300	-	115 + 90° M16: 190 + 90°	300, slacken, 50 + 30° N
Rear hubs.....Nm	WSM	WSM	WSM	175 N
Wheel nuts / bolts.....Nm	110	120	120	120
Glow plugs.....Nm	25	15	15	15
Clutch pressure plate bolts.....Nm	25	20	20	20
Injection pump sprocket.....Nm	25	-	20 + 90° N	20 + 90° N
Injectors.....Nm	70	-	20	20
Injection pump mounting bolts.....Nm	25	-	25	25
Injector pipe unions.....Nm	25	-	25	25

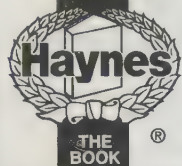
Capacities

Engine oil & filter.....litres	5.0	4.5	4.5	5.2
Gearbox.....litres	2.4	1.6	2.0	2.0
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	6.0	5.0	6.3	6.3
Fuel tank.....litres	42	-	62	55

Notes



- Not applicable, or information not available



SSANGYONG

	Korando 2.9 D 1997 to 1998	Musso 2.9 D 1995 to 1998	Musso 2.9 TD 1997 to 1998	
Engine				
Engine type/code.....	OM602 SOHC 58kW	OM602 SOHC 70kW	OM662LA SOHC Turbo 87kW	
Capacity (cm ³) / cylinders.....	2874 / 4	2874 / 5	2874 / 5	
Compression ratio / pressure.....bar	22.0 / 18 to 28	22.0 / 18 to 28	22.0 / 18 to 28	
Torque outputNm	190	190	250	
Oil pressureidle [running] bar	-	-	-	
Oil temperature°C	-	-	-	
Valve clearances - inlet (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	
- exhaust (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	
Injection order.....	1-3-4-2	1-2-4-5-3	1-2-4-5-3	
No. 1 cylinder position.....	TCE	TCE	TCE	
Cooling system				
Thermostat opening temperature°C	-	85	80	
Radiator cap pressurebar	-	-	-	
Fuel system				
Idle speedrpm	700 ± 50	700 ± 50	770 ± 50	
Maximum (no load) speedrpm	4600	4600	4600	
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	
Static timing method.....	Refer to wsm	Refer to wsm	Refer to wsm	
Timing dimension.....mm	-	-	-	
Crankshaft positionmm [°]	-	-	-	
Turbo type / ref / pressure.....bar	-	-	-	
Injection pump make.....	Bosch	Bosch	Bosch	
Injection pump part no.....	601 070 2201	602 070 7501	C320 RS 191	
Injector Make / type.....	Bosch	Bosch	Bosch	
Injector part no.....	-	-	-	
Injection type.....	Indirect PES 4M	Indirect PES 5M	Indirect PES 5M	
Injection opening pressure, New [used]...bar	115 to 125 [100]	115 to 125 [100]	115 to 125 [100]	
Glow plugs				
Maker.....	Bosch	Bosch/Champion	-	
Type.....	0250 201 026	0250 201 026 / CH156	-	
Nominal rating.....V/A	11.5 / 30	11.5 / 30	-	
Brakes				
minimum friction material thickness				
Front.....mm	-	2.0	2.0	
Rear.....mm	-	1.5	1.5	
Tyres - Saloon / Hatch.....Size	-	-	-	
- Estate / Van.....Size	235/75x15	235/75x15	235/75x15	
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	
- Estate / Van.....bar	2.1 / 2.1	2.1 / 2.1	2.1 / 2.1	
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.4	0.4	0.4	
Camber.....	0° ± 30'	0° ± 30'	0° ± 30'	
Castor.....	2°30' ± 30'	2°30' ± 30'	2°30' ± 30'	
King pin inclination.....	12°30'	12°30'	12°30'	
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-	-	
Camber.....	-	-	-	



SSANGYONG

	Korando 2.9 D 1997 to 1998	Musso 2.9 D 1995 to 1998	Musso 2.9 TD 1997 to 1998	
Torque wrench settings				
Cylinder head - stage 1Nm	10 N	15 N	15 N	
- stage 2Nm	35	35	35	
- stage 3Nm	+ 90°	+ 90°	+ 90°	
- stage 4Nm	Wait 10 mins	Wait 10 mins	+ 90°	
- stage 5Nm	+ 90°	+ 90°	-	
- stage 6Nm	-	-	-	
Big-end bearings.....Nm	35 + 90° N	35 + 90° N	40 + 90° N	
Main bearings.....Nm	35 + 90° N	35 + 90° N	55 + 90° N	
Crankshaft pulley boltNm	200 + 90°	-	-	
Camshaft pulley boltNm	25 + 90°	25 + 90°	-	
Flywheel [driveplate] bolt.....Nm	45 + 90° N	45 + 90° N	45 + 90° N	
Front hubs.....Nm	WSM	WSM	WSM	
Rear hubs.....Nm	WSM	WSM	WSM	
Wheel nuts / boltsNm	120	120 Alloy: 136	120 Alloy: 136	
Glow plugsNm	20	20	20	
Clutch pressure plate boltsNm	23	23	35	
Injection pump sprocket.....Nm	-	-	-	
Injectors.....Nm	40	40	-	
Injection pump mounting boltsNm	25	25	-	
Injector pipe unions.....Nm	18	18	-	
Capacities				
Engine oil & filter.....litres	8.0	9.5	9.5	
Gearbox.....litres	2.0	2.0	2.0	
Automatic transmissionlitres	10.0	9.0	-	
Final drive.....litres	1.4 Rear: 1.9	1.4 Rear: 1.9 ¹	1.4 Rear: 1.9 ¹	
Cooling system.....litres	10.0	10.0	10.0	
Fuel tank.....litres	-	70	80	

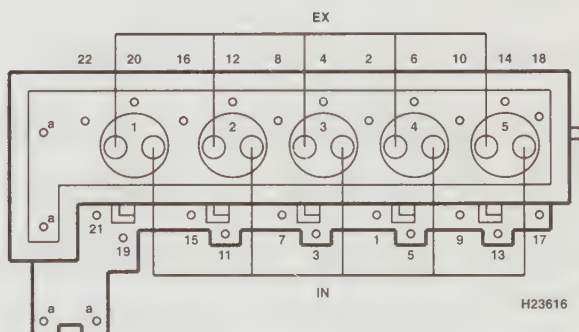
Notes

Musso 2.9 D 1995 to 1998

¹Transfer: 1.4

Musso 2.9 TD 1997 to 1998

¹Transfer: 1.4



2439 cm³ / 2874 cm³



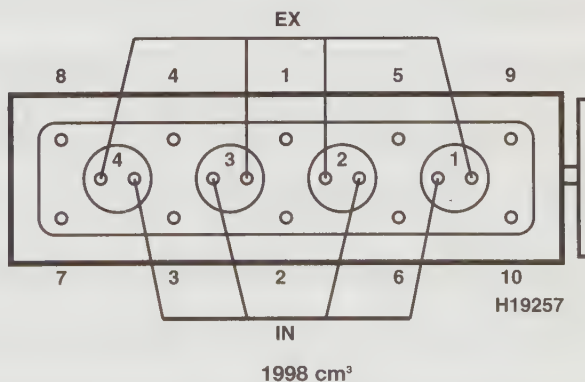
SUZUKI

	Vitara 2.0 D 1996 to 2000			
Engine				
Engine type/code	RFL4 SOHC 65kW			
Capacity (cm ³) / cylinders	1998 / 4			
Compression ratio / pressure	20.5 / 27 to 30			
Torque output	Nm 159			
Oil pressureidle [running] bar	[3.9 @ 3000]			
Oil temperature°C	80			
Valve clearances - inlet (mm)	0.20 to 0.25			
- exhaust (mm)	0.30 to 0.35			
Injection order	1-3-4-2			
No. 1 cylinder position	TBE			
Cooling system				
Thermostat opening temperature°C	80 or 88			
Radiator cap pressure	bar 0.9			
Fuel system				
Idle speedrpm	770 ± 50 N/A			
Maximum (no load) speedrpm	-			
Smoke test/opacityM ⁻¹ %	2.5			
Static timing method.....	Refer to wsm			
Timing dimension.....mm	-			
Crankshaft positionmm [°]	-			
Turbo type / ref / pressure	-			
Injection pump make	-			
Injection pump part no.....	-			
Injector Make / type	-			
Injector part no.....	-			
Injection type.....	Indirect			
Injection opening pressure, New [used]...bar	147			
Glow plugs				
Maker	-			
Type	-			
Nominal rating.....V/A	-			
Brakes				
minimum friction material thickness				
Front.....mm	8.0 with backing			
Rear.....mm	1.0			
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	215/65x16			
Pressure - front / rear - Saloon / Hatch...bar	-			
- Estate / Vanbar	1.6 / 1.6			
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 to 6.0			
Camber	30' ± 1°			
Castor	2° ± 1°			
King pin inclination.....	-			
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-			
Camber	-			

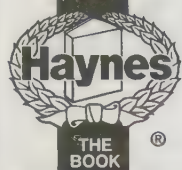
Cylinder head - stage 1	Nm	30°
- stage 2	Nm	+ 90°
- stage 3	Nm	+ 90°
- stage 4	Nm	-
- stage 5	Nm	-
- stage 6	Nm	-
Big-end bearings.....	Nm	65 N
Main bearings.....	Nm	87
Crankshaft pulley bolt	Nm	175
Camshaft pulley bolt	Nm	60
Flywheel [driveplate] bolt.....	Nm	100
Front hubs	Nm	120 to 170
Rear hubs	Nm	120 to 200
Wheel nuts / bolts	Nm	95
Glow plugs	Nm	18
Clutch pressure plate bolts	Nm	-
Injection pump sprocket.....	Nm	65
Injectors.....	Nm	65
Injection pump mounting bolts	Nm	23
Injector pipe unions.....	Nm	28

Engine oil & filter.....litres	5.5	
Gearbox.....litres	1.5	Transfer: 1.7
Automatic transmissionlitres	2.5	
Final drive.....litres		Front: 1.0 Rear: 2.2
Cooling system.....litres	6.6	
Fuel tank.....litres	70	

Vitara 2.0 D 1996 to 2000
 1 Bolt length below head ≤ 114.5 mm



– Not applicable, or information not available



TATA

	Loadbeta 2.0 D 1994 to 2000			
Engine				
Engine type/code.....	483 DL 44 SOHC 46KW			
Capacity (cm ³) / cylinders.....	1948 / 4			
Compression ratio / pressurebar	22.0 /			
Torque outputNm	115			
Oil pressureidle [running] bar	1.2			
Oil temperature°C	80			
Valve clearances - inlet (mm)	0.15			
- exhaust (mm)	0.30			
Injection order	1-3-4-2			
No. 1 cylinder position	-			
Cooling system				
Thermostat opening temperature°C	87.2			
Radiator cap pressurebar	1.0			
Fuel system				
Idle speedrpm	850 ± 50			
Maximum (no load) speedrpm	4750 to 4850			
Smoke test/opacityM ⁻¹ %	2.5			
Static timing method.....	Rotor lift			
Timing dimension.....mm	0.78 ± 0.02			
Crankshaft positionmm [°]	TDC			
Turbo type / ref / pressurebar	-			
Injection pump make	Lucas			
Injection pump part no.....	VE			
Injector Make / type	-			
Injector part no.....	Mico DNOSO287			
Injection type.....	Indirect VE			
Injection opening pressure, New [used]...bar	140 ± 8			
Glow plugs				
Maker	Bosch			
Type	0250 201 019			
Nominal ratingV/A	12 / 12			
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing			
Rear.....mm	1.5			
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/80x15; 215/70x15'			
Pressure - front / rear - Saloon / Hatch...bar	-			
- Estate / Van.....bar	2.2 / 2.2			
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-			
Camber	0° ± 20'			
Castor	3° ± 20'			
King pin inclination.....	-			
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-			
Camber	-			



TATA

Loadbeta 2.0 D 1994 to 2000

Torque wrench settings

Cylinder head - stage 1	Nm	30
- stage 2	Nm	60
- stage 3	Nm	Slacken, 60
- stage 4	Nm	Warm up, allow to cool
- stage 5	Nm	Slacken, 90
- stage 6	Nm	Slacken, 90

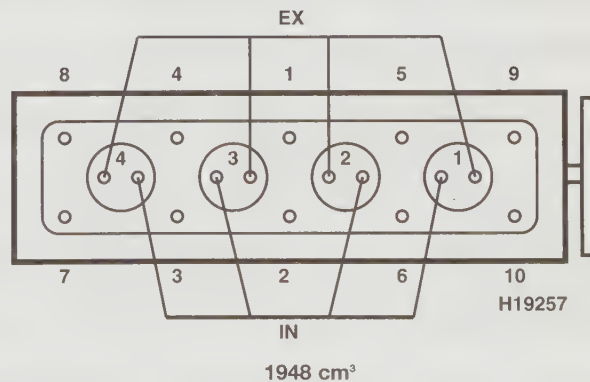
Big-end bearings	Nm	49 N
Main bearings	Nm	68
Crankshaft pulley bolt	Nm	40 + 60°
Camshaft pulley bolt	Nm	35
Flywheel [driveplate] bolt	Nm	49
Front hubs	Nm	-
Rear hubs	Nm	245
Wheel nuts / bolts	Nm	130
Glow plugs	Nm	22
Clutch pressure plate bolts	Nm	50
Injection pump sprocket	Nm	49
Injectors	Nm	88
Injection pump mounting bolts	Nm	23
Injector pipe unions	Nm	20

Capacities

Engine oil & filter	litres	6.8
Gearbox	litres	1.5
Automatic transmission	litres	-
Final drive	litres	1.9
Cooling system	litres	10.0
Fuel tank	litres	50

Notes

Loadbeta 2.0 D 1994 to 2000
1 250/70x15



- Not applicable, or information not available



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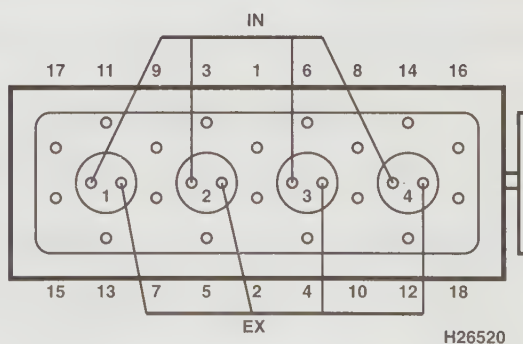
	Corolla 2.0 D 1993 to 1997	Corolla 2.0 D 1998 to 2000	Carina 2.0 (CT170) 1990 to 1992	Carina E 2.0 D 1992 to 1996
Engine				
Engine type/code.....	2C SOHC 52kW	2C-E SOHC 52kW	2C SOHC 53kW	2C SOHC 53kW
Capacity (cm ³) / cylinders.....	1975 / 4	1975 / 4	1974 / 4	1975 / 4
Compression ratio / pressurebar	23.1 / ≥24.5	23.1 / 24.5 to 29.4	23.0 / ≥25.0	23.0 / 24.5 to 29.4
Torque outputNm	13	132	132	132
Oil pressureidle [running] bar	[2.5 to 5.0 @ 3000]	[2.5 to 5.0 @ 3000]	[2.5 to 5.0 @ 3000]	[2.5 to 5.0 @ 3000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.20 to 0.30	0.20 to 0.30	0.20 to 0.30	0.20 to 0.30
- exhaust (mm)	0.25 to 0.35	0.25 to 0.35	0.25 to 0.35	0.25 to 0.35
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	80	80	80 to 84	80
Radiator cap pressurebar	0.7 to 1.03	1.03	0.75 to 1.05	0.7 to 1.03
Fuel system				
Idle speedrpm	800 ± 50	800 ± 50	750 to 850	800 ± 50
Maximum (no load) speedrpm	5350 ± 50	5350 ± 50	5350	5350
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	0.55 to 0.61	0.38 to 0.58	0.77 to 0.83	0.55 to 0.61
Crankshaft positionmm [°]	0 TDC	0 TDC	[0] TDC	0 TDC
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make	Nippon Denso	Nippon Denso	Nippon Denso	Nippon Denso
Injection pump part no.....	VE	VE	VE	VE
Injector Make / type.....	Nippon Denso	Nippon Denso	Nippon Denso	Nippon Denso
Injector part no.....	DNOPD600	DNOPD650	DNOPD4	DNOPD600
Injection type.....	Indirect VE	Indirect VE	Indirect VE	Indirect VE
Injection opening pressure, New [used]...bar	147 to 157 [137]	145 to 155 [137 to 156]	135 to 155	147 to 157 [137 to 157]
Glow plugs				
Maker	Bosch/Champion	-	Bosch/Champion	Bosch/Champion
Type	0250 202 052 / CH95	-	0250 202 052 / CH95	0250 202 052 / CH95
Nominal rating.....V/A	-	-	7 / 8.5	-
Brakes				
minimum friction material thickness				
Front.....mm	1.0	1.0	1.0	1.0
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	165/70x14; 165/65x14	175/65x14	165x13; 165/80x13	175/70x14
Pressure - front / rear - Saloon / Hatch...bar	2.4 / 2.1	2.1 / 2.1	2.1 / 1.9	2.2 / 2.1
- Estate / Vanbar	-	2.1 / 2.2	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 ± 1.0	-1.0 ± 2.0	0 ± 1.0	0.0 ± 2.0
Camber	-0°13'	-0°13' ± 45'	0° ± 30'	-0°20' ± 45'
Castor	1°24'	1°24' ± 45'	-5° ± 30' PAS: 20'±30'	0°30' ± 45'
King pin inclination.....	12°41'	12°41' ± 45	13°15' ± 30'	13°25' ± 45'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	3.0 ± 2.0	4.0 ± 2.0	5.0 ± 1.0	4.0 ± 2.0
Camber	-0°55' ± 45'	1°45' ± 45'	-30' ± 30'	-0°35' ± 45'



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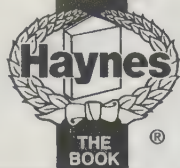
	Corolla 2.0 D 1993 to 1997	Corolla 2.0 D 1998 to 2000	Carina 2.0 (CT170) 1990 to 1992	Carina E 2.0 D 1992 to 1996
Torque wrench settings				
Cylinder head - stage 1Nm	44	44	20	44
- stage 2Nm	+ 90°	+ 90°	50	+ 90°
- stage 3Nm	+ 90°	+ 90°	84	+ 90°
- stage 4Nm	-	-	-	-
- stage 5Nm	-	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	64 N	64 N	64 N	64 N
Main bearings.....Nm	103	103	103	103
Crankshaft pulley boltNm	98	196	98	496
Camshaft pulley boltNm	88	88	98	88
Flywheel [driveplate] bolt.....Nm	88	88	88	88
Front hubsNm	216	216	186	226
Rear hubsNm	123	123	123	123
Wheel nuts / boltsNm	103	100	103	103
Glow plugsNm	13	13	13	13
Clutch pressure plate boltsNm	19	20	18	19
Injection pump sprocket.....Nm	47	65	64	64
Injectors.....Nm	64	64	64	64
Injection pump mounting boltsNm	47	46	-	47
Injector pipe unions.....Nm	29	30	27	29
Capacities				
Engine oil & filter.....litres	4.2	4.2	4.3	4.2
Gearbox.....litres	2.6	2.6	2.6	2.6
Automatic transmissionlitres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	5.3	5.3	7.5	7.4
Fuel tank.....litres	50	50	60	60

Notes



1975 cm³

- Not applicable, or information not available



TOYOTA

	Carina E 2.0 TD 1996 to 1997	Avenis 2.0 TD 1997 to 1999	Camry 2.0 Turbo (CV20) 1987 to 1991	Picnic 2.2 TD 1997 to 2000
Engine				
Engine type/code.....	2C-T SOHC Turbo 60kW	2C-TE OHC Turbo 62kW	2C-T SOHC Turbo 61kW	3C-TE SOHC Turbo 63kW
Capacity (cm ³) / cylinders.....	1975 / 4	1975 / 4	1975 / 4	2184 / 4
Compression ratio / pressure.....bar	23.0 / 24.5 to 29.4	23.1 / ≥24.2	23.0 / ≥25.0	22.6 / 29
Torque output.....Nm	173	203	0	205
Oil pressure.....idle [running] bar	[2.5 to 5.0 @ 3000]	0.3 [2.5 to 6.0 @ 3000]	[2.5 to 6.0 @ 3000]	3.7
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0.20 to 0.30	0.20 to 0.30	0.20 to 0.30	0.20 to 0.30
- exhaust (mm).....	0.25 to 0.35	0.25 to 0.35	0.25 to 0.35	0.25 to 0.35
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature.....°C	80	80 to 84	80 to 84	80
Radiator cap pressure.....bar	0.7 to 1.03	0.75 to 1.05	0.75 to 1.00	1.0
Fuel system				
Idle speed.....rpm	800 ± 50	725 to 825	750 to 850	700 to 800
Maximum (no load) speed.....rpm	5350	5300	5300 to 5400	4900 to 5100
Smoke test/opacity.....M ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Rotor lift
Timing dimension.....mm	0.55 to 0.61	0.38 to 0.58	0.77 to 0.83	0.55 to 0.61
Crankshaft position.....mm [°]	0 TDC	0 TDC	[0] TDC	TDC
Turbo type / ref / pressure.....bar	0.5 to 0.7 bar	0.5 to 0.7 bar	-	0.5 to 0.7 bar
Injection pump make.....	Nippon Denso	Nippon Denso	Nippon Denso	Nippon Denso
Injection pump part no.....	VE	VE	VE	Electronic control
Injector Make / type.....	Nippon Denso	Nippon Denso	Nippon Denso	-
Injector part no.....	-	DNOPD650	DNOPD4	DNOPD650
Injection type.....	Indirect VE	Indirect VE	Indirect VE	Indirect
Injection opening pressure, New [used]...bar	147 to 157 [137 to 157]	147 to 157 [137 to 157]	147 to 157 [137 to 157]	145 to 156
Glow plugs				
Maker.....	-	-	-	-
Type.....	-	-	-	-
Nominal rating.....V/A	11 / 15.3	11 / 15.3	-	-
Brakes				
minimum friction material thickness				
Front.....mm	1.0	1.0	1.0	1.0
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175/70x14	185/65x14: 195/65x15	185/70x14	-
Pressure - front / rear - Saloon / Hatch...bar	-	185/65x14: 195/65x15	-	195/65x14
- Estate / Van.....bar	2.2 / 2.1	2.2/2.2: 2.2/2.2	1.9 / 1.9	-
	-	2.2/2.2: 2.2/2.2	-	2.5 / 2.5
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-0.6 ± 1.2	1.0 ± 2.0	1.0 ± 1.0	2.0 ± 2.0
Camber.....	-0°22' ± 45'	-0°21' ± 45'	35' ± 45'	-0°22' ± 45'
Castor.....	1°18' ± 45'	1°20' ± 45'	1°40' ± 30'	0°55' ± 45'
King pin inclination.....	13°24' ± 45'	13°22' ± 45'	12°40' ± 45'	13° 17' ± 45'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.2 ± 1.2	2.0 ± 2.0	4.0 ± 1.0	1.0 ± 3.0
Camber.....	-0°55' ± 45'	-0°28' ± 30'	-35' ± 45'	-0°55' ± 45'



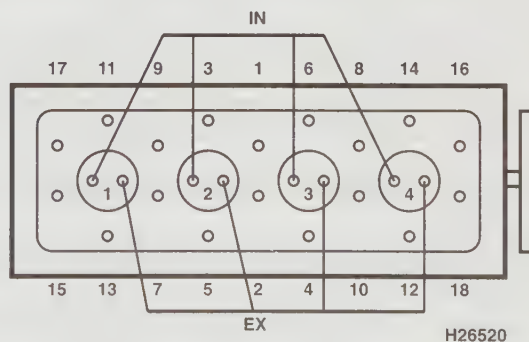
TOYOTA

	Carina E 2.0 TD 1996 to 1997	Avenis 2.0 TD 1997 to 1999	Camry 2.0 Turbo (CV20) 1987 to 1991	Picnic 2.2 TD 1997 to 2000
Torque wrench settings				
Cylinder head - stage 1Nm	44	59	20	44
- stage 2Nm	+ 90°	+ 90°	50	+ 90°
- stage 3Nm	+ 90°	+ 90°	84	+ 90°
- stage 4Nm	-	-	-	-
- stage 5Nm	-	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	64 N	64 N	64 N	64 N
Main bearings.....Nm	103	103	103	100
Crankshaft pulley bolt.....Nm	496	196	98	-
Camshaft pulley bolt.....Nm	88	88	98	-
Flywheel [driveplate] bolt.....Nm	88	88.2	88	88
Front hubs.....Nm	226	216	186 ¹	216
Rear hubs.....Nm	123	123	103	WSM
Wheel nuts / bolts.....Nm	103	103	103	100
Glow plugs.....Nm	13	13	13	-
Clutch pressure plate bolts.....Nm	19	19	18	20
Injection pump sprocket.....Nm	64	64	64	-
Injectors.....Nm	64	64	64	-
Injection pump mounting bolts.....Nm	47	-	-	-
Injector pipe unions.....Nm	29	29	27	-
Capacities				
Engine oil & filter.....litres	4.2	5.1	4.6	4.1
Gearbox.....litres	2.6	2.2	2.6	2.6
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	7.4	6.1 [AT: 6.0]	7.5	-
Fuel tank.....litres	60	60	60	60

Notes

Camry 2.0 Turbo (CV20) 1987 to 1991

¹If noisy, retighten to 273



1975 cm³



TOYOTA

	Land Cruiser Colorado 3.0 TD 1996 to 2000	Land Cruiser Amazon 4.2 TD 1998 to 2000	Land Cruiser 4.2 TD 1990 to 1997	Land Cruiser II 2.4 (LJ70) 1990 to 1993
Engine				
Engine type/code.....	1KZ-T SOHC Turbo 91kW	1HD-FTE SOHC Turbo 148kW	1HD-T SOHC Turbo 121kW	2L-T SOHC Turbo 66kW
Capacity (cm ³) / cylinders.....	2982 / 4	4164 / 6	4164 / 6	2446 / 4
Compression ratio / pressurebar	21.2 / 19.6 to 30.4	18.8 / ≥24.5	18.6 / 25 to 34	20.0 / 19.6 to 30.4
Torque outputNm	295	430	360	0
Oil pressureidle [running] bar	[2.5 to 6.1 @ 3000]	[2.5 @ 3000]	[2.5 to 6.0 @ 3000]	[2.5 to 5.9 @ 3000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.20 to 0.30	0.17 to 0.23	0.20	0.25 H
- exhaust (mm)	0.25 to 0.35	0.47 to 0.53	0.40	0.36 H
Injection order.....	1-3-4-2	-	1-4-3-6-2-5	1-3-4-2
No. 1 cylinder position	TBE	F	F	F
Cooling system				
Thermostat opening temperature°C	80	78	74 to 78	86 to 90
Radiator cap pressurebar	1.05	1.2	0.75 to 1.00	0.75 to 1.00
Fuel system				
Idle speedrpm	700 ± 50	700 ± 50	650	700 to 800
Maximum (no load) speedrpm	4600 ± 130	4300 to 4500	4400	4700 to 4900
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Plunger travel	Refer to wsm	Plunger travel	Plunger travel
Timing dimension.....mm	0.58 to 0.62	-	1.29 to 1.35	0.97
Crankshaft positionmm [°]	0 TDC	-	[0] TDC	[0] TDC
Turbo type / ref / pressurebar	0.52 to 0.68 bar @ 4000 rpm	0.5 to 0.7 bar @ 4300 rpm	0.49 to 0.63 bar @ ≥2000 rpm	0.61 to 0.81 bar @ ≥2000 rpm
Injection pump make	Nippon Denso	Nippon Denso	Nippon Denso	Nippon Denso
Injection pump part no.....	VE 22100 67070	VE	VE	VE
Injector Make / type.....	Nippon Denso	Nippon Denso	Nippon Denso	Nippon Denso
Injector part no.....	DNOPD 619	-	KBAL 2 stage	DN-DN12SD 12
Injection type.....	Indirect VE	Direct VE	Indirect VE	Indirect VE
Injection opening pressure, New [used]...bar	148 to 158 [143 to 151]	340 to 350	129 to 135'	148 to 156 [147]
Glow plugs				
Maker	Beru	-	Bosch	Bosch
Type	968MJ	-	0250 202 079	0250 202 073
Nominal rating.....V/A	-	-	-	7 / 8
Brakes				
minimum friction material thickness				
Front.....mm	1.0	1.0	1.0	1.0
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	215/80x16 ²	275/70x16	275/70x15	265/75x15
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	1.8 / 2.0 ³	2.2 / 2.2	2.2 / 2.2	1.8 / 2.0
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 ± 2.0	1.0 ± 2.0	2.0 ± 1.0	1.0 ± 1.0
Camber	-0°10' ± 45'	0°5' ± 45'	1° ± 45'	1° ± 1°
Castor	2°55' ± 45'	2°25' ± 45'	3° ± 1°	4°5' ± 1°
King pin inclination.....	10°55' ± 45'	12°10' ± 45'	13° ± 45'	9°30' ± 1°
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-	-	-
Camber	-	-	-	-



TOYOTA

	Land Cruiser Colorado 3.0 TD 1996 to 2000	Land Cruiser Amazon 4.2 TD 1998 to 2000	Land Cruiser 4.2 TD 1990 to 1997	Land Cruiser II 2.4 (LJ70) 1990 to 1993
Torque wrench settings				
Cylinder head - stage 1.....Nm	39	69 ²	69	78
- stage 2.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 3.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4.....Nm	-	-	-	-
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	29 + 90° N	37 + 90° N	37 + 90° N	34 + 120° N
Main bearings.....Nm	49 + 90°	103 + 90°	103 + 90°	103
Crankshaft pulley bolt.....Nm	235	430	490	137
Camshaft pulley bolt.....Nm	100	98	98	98
Flywheel [driveplate] bolt.....Nm	145	127	127 [54]	123
Front hubs.....Nm	WSM	WSM	WSM	-
Rear hubs.....Nm	WSM	WSM	WSM	-
Wheel nuts / bolts.....Nm	158	209 Alloy: 131	147	158
Glow plugs.....Nm	13	-	13	13
Clutch pressure plate bolts.....Nm	20	39	39	19
Injection pump sprocket.....Nm	64	98	98	64
Injectors.....Nm	64	-	39	69
Injection pump mounting bolts.....Nm	18	69	-	-
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	8.0	11.4	9.3	6.7
Gearbox.....litres	2.2	2.7	2.6 Transfer: 1.3	2.6 Transfer: 2.1
Automatic transmission.....litres	2.0	6.0	6.0	-
Final drive.....litres	1.1 Rear: 2.6 ¹	1.7 Rear: 3.2 ¹	Front: 2.7 ²	Front: 2.0 ¹
Cooling system.....litres	11.0	13.2 AT: 12.8	12.0	10.9
Fuel tank.....litres	90	96	90	90

Notes

Land Cruiser Colorado 3.0 TD 1996 to 2000

¹Transfer box: 1.1

²Stn Wagon 3/5dr: 265/70x16

³Stn Wagon 3/5dr: 2.0 / 2.0

Land Cruiser Amazon 4.2 TD 1998 to 2000

¹Transfer box: 1.3

²Shank diameter: ≥10.55 mm

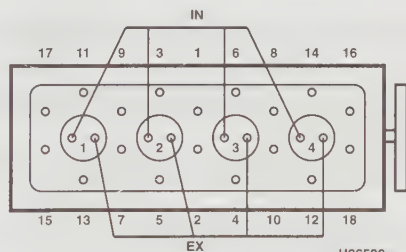
Land Cruiser 4.2 TD 1990 to 1997

¹2nd stage: 176 to 186

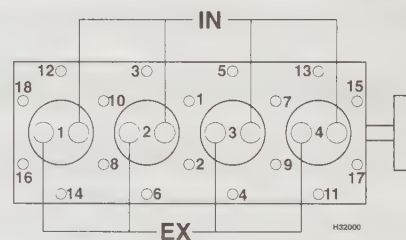
²Rear: 2.8

Land Cruiser II 2.4 (LJ70) 1990 to 1993

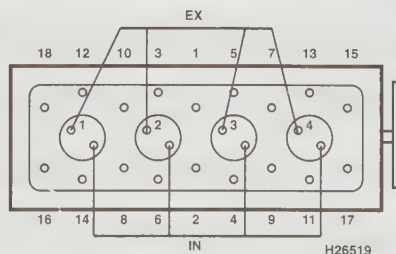
¹Rear: 1.9



2982 cm³

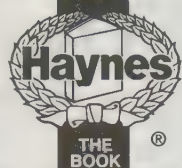


4164 cm³



2446 cm³

- Not applicable, or information not available



TOYOTA

	Land Cruiser II 3.0 TD 1993 to 1996	Land Cruiser Colorado 3.0 TD 1996 to 1999	Lite-Ace 2.0 D 1992 to 1994	Lite-Ace/Power Van 2.4 D 1996 to 2000
Engine				
Engine type/code.....	1KZ-T SOHC Turbo 92kW	1KZ-TE SOHC Turbo 91kW	2C SOHC 53kW	2L SOHC 56kW
Capacity (cm ³) / cylinders.....	2982 / 4	2982 / 4	1975 / 4	2446 / 4
Compression ratio / pressure.....bar	21.2 / 19.6 to 31	21.2 / 19.6 to 30.4	22.5 / 24.5 to 29.4	22.2 / 19.6 to 30.7
Torque output.....Nm	218	295	0	157
Oil pressure.....idle [running] bar	[2.5 to 6.0 @ 3000]	[2.9 to 5.4 @ 3000]	[2.5 to 5.9 @ 3000]	[3.0 to 5.4 @ 3000]
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0.20 to 0.30	0.20 to 0.30	0.20 to 0.30	0.25
- exhaust (mm).....	0.25 to 0.35	0.25 to 0.35	0.25 to 0.35	0.45
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature.....°C	80	80	-	86
Radiator cap pressure.....bar	0.75 to 1.05	0.75 to 1.05	-	0.75 to 1.05
Fuel system				
Idle speed.....rpm	750 ± 50	700 ± 50	750 to 850	700 ± 50
Maximum (no load) speed.....rpm	4730	4600	5300	5280
Smoke test/opacity.....M ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	0.39 to 0.43	0.58 to 0.62	0.77 to 0.83	0.54 to 0.66
Crankshaft position.....mm [°]	0 TDC	-	0 TDC	0 TDC
Turbo type / ref / pressure.....bar	0.52 to 0.68 bar @ 4600 rpm	0.52 to 0.68 bar @ 4600 rpm	-	-
Injection pump make.....	Nippon Denso	Nippon Denso	Nippon Denso	Nippon Denso
Injection pump part no.....	VE	VE 22100 67070	-	VE
Injector Make / type.....	Diesel Kiki	Nippon Denso	Nippon Denso	Nippon Denso
Injector part no.....	DNOPD619	DNOPD619	DNOPD4	DN4PD57
Injection type.....	Indirect VE	VE	-	VE
Injection opening pressure, New [used]...bar	148 to 156 [147]	148 to 156 [143 to 151]	142 to 152 [132]	146 to 155 [142 to 152]
Glow plugs				
Maker.....	-	Beru	Bosch/Champion	Bosch/Champion
Type.....	-	968MJ	0250 202 052 / CH95	0250 202 053 / CH103
Nominal rating.....V/A	-	-	7 / 8.5	-
Brakes				
minimum friction material thickness				
Front.....mm	1.0	1.0	1.0	1.0
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	265/75x15	215/80x16	-	195/70x15
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Van.....bar	1.8 / 2.0	1.8 / 2.0	-	3.3 / 4.4
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 ± 1.0	2.0 ± 2.0	0.2 ± 0.5	[0°30' ± 20°]
Camber.....	1° ± 1°	-0°10' ± 45'	-0°10' ± 45'	0°10' ± 45'
Castor.....	4°5' ± 1°	2°55' ± 45'	1°47' ± 45'	1°40' ± 45'
King pin inclination.....	9°30' ± 1°	-	10°40'	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-	-	[0°10' ± 20°]
Camber.....	-	-	-	0°30' ± 45'



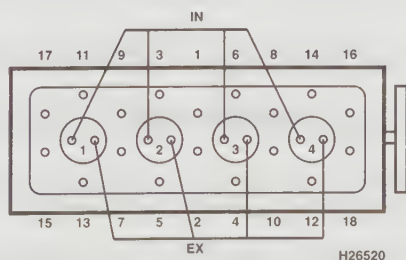
TOYOTA

	Land Cruiser II 3.0 TD 1993 to 1996	Land Cruiser Colorado 3.0 TD 1996 to 1999	Lite-Ace 2.0 D 1992 to 1994	Lite-Ace/Power Van 2.4 D 1996 to 2000
Torque wrench settings				
Cylinder head - stage 1.....Nm	39	39	44	78
- stage 2Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 3Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4Nm	-	-	-	-
- stage 5Nm	-	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	29 + 90° N	29 + 90° N	64 N	34 + 120° N
Main bearings.....Nm	49 + 90°	49 + 90°	103	103
Crankshaft pulley bolt.....Nm	363	235	98	235
Camshaft pulley bolt.....Nm	98	100	88	98
Flywheel [driveplate] bolt.....Nm	145	145	88	123
Front hubs.....Nm	WSM	WSM	WSM	WSM
Rear hubs.....Nm	WSM	WSM	WSM	290
Wheel nuts / bolts.....Nm	158	158	103	103
Glow plugs.....Nm	13	13	13	13
Clutch pressure plate bolts.....Nm	19	19	19	19
Injection pump sprocket.....Nm	64	64	64	64
Injectors.....Nm	64	64	64	65
Injection pump mounting bolts.....Nm	21	18	-	18
Injector pipe unions.....Nm	15	25	29	25
Capacities				
Engine oil & filter.....litres	8.0	8.0	4.2	6.7
Gearbox.....litres	Transfer: 2.1	2.2 Transfer: 1.0	2.2	2.4
Automatic transmission.....litres	-	9.5	-	-
Final drive.....litres	1.98 ¹	1.1 Rear: 2.6	-	1.8
Cooling system.....litres	11.0	11.0	6.3 to 7.5	10.9
Fuel tank.....litres	90	90	-	75

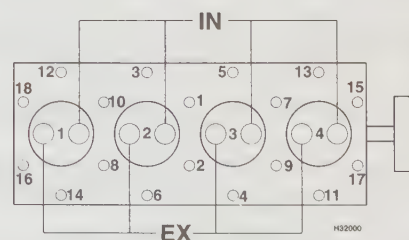
Notes

Land Cruiser II 3.0 TD 1993 to 1996

¹Rear: 1.85



1975 cm³ / 2982 cm³



2446 cm³

- Not applicable, or information not available



TOYOTA

	Hi-Lux 2.4 4x4 (LN105) 1988 to 1996	Hi-Lux 2.4 D 1997 to 2000	Hi-Lux 2.4 TD 1997 to 2000	4Runner 3.0 TD 1993 to 1996
Engine				
Engine type/code.....	2L SOHC 60kW	2L SOHC 55kW	2L-T SOHC Turbo 63kW	1KZ-T SOHC Turbo 92kW
Capacity (cm ³) / cylinders.....	2446 / 4	2446 / 4	2446 / 4	2982 / 4
Compression ratio / pressure.....bar	22.2 / ≥20.0	22.2 / ≥19.6	21.0 / ≥19.6	21.2 / 19.6 to 31.4
Torque output.....Nm	165	157	218	218
Oil pressure.....idle [running] bar	[2.5 to 5.9 @ 3000]	[3.0 @ 3000]	[3.0 @ 3000]	[2.9 to 5.5 @ 3000]
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0.25	0.25	0.20 to 0.30	0.20 to 0.30
- exhaust (mm).....	0.36	0.45	0.40 to 0.50	0.25 to 0.35
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	F	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature.....°C	80 to 84	86	86	80
Radiator cap pressure.....bar	0.7 to 1.0	0.75 to 1.0	0.75 to 1.0	0.75 to 1.05
Fuel system				
Idle speed.....rpm	700	650 to 750	650 to 750	700 ± 50
Maximum (no load) speed.....rpm	4900	5020 to 5280	4670 to 4930	4600
Smoke test/opacity.....M ⁻¹ %	2.5	2.5	2.5	2.5
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	0.54 to 0.66	0.54 to 0.66	0.51 to 0.66	0.39 to 0.43
Crankshaft position.....mm [°]	[0] TDC	TDC	TDC	0 TDC
Turbo type / ref / pressure.....bar	-	-	0.6 to 0.8 bar	0.57 to 0.64 bar @ 4600
Injection pump make.....	Nippon Denso	Nippon Denso	Nippon Denso	Nippon Denso
Injection pump part no.....	VE 22100 54750	-	-	VE 22100 67040
Injector Make / type.....	Nippon Denso	Nippon Denso	Nippon Denso	Nippon Denso
Injector part no.....	DN-DN4SDND 133	DN12SD12	DN12SD12	DNOPD619
Injection type.....	Indirect VE	Indirect	Indirect	VE
Injection opening pressure, New [used]...bar	148 to 156 [142 to 152]	148 to 156 [142 to 152]	148 to 156 [142 to 152]	148 to 156 [147]
Glow plugs				
Maker.....	Bosch/Champion	Bosch/Champion	Champion	-
Type.....	0250 202 053 / CH103	0250 202 053 / CH154	CH154	-
Nominal rating.....V/A	7 / 8	11 /	11 /	-
Brakes				
minimum friction material thickness				
Front.....mm	1.0	1.0	1.0	1.0
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	205x16	185x14	205x16	265/70x15
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Van.....bar	1.7 / 2.4	1.8 / 1.8	1.7 / 2.4	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 ± 1.0	3.0 ± 1.0	1.0 ± 1.0	1.0 ± 2.0
Camber.....	1° ± 45'	0°20' ± 30'	1° ± 45'	0°45' ± 45'
Castor.....	1°30' ± 30'	0°45' ± 45'	1°30' ± 45'	2°30' ± 45'
King pin inclination.....	9°30' ± 45'	10°10' ± 30'	9°30' ± 45'	11°50' ± 45'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-	-	-
Camber.....	-	-	-	-



TOYOTA

	Hi-Lux 2.4 4x4 (LN105) 1988 to 1996	Hi-Lux 2.4 D 1997 to 2000	Hi-Lux 2.4 TD 1997 to 2000	4Runner 3.0 TD 1993 to 1996
Torque wrench settings				
Cylinder head - stage 1	Nm 38 ⁴	78	78	39
- stage 2	Nm 78	+ 90°	+ 90°	+ 90°
- stage 3	Nm + 90°	+ 90°	+ 90°	+ 90°
- stage 4	Nm + 90°	-	-	-
- stage 5	Nm -	-	-	-
- stage 6	Nm -	-	-	-
Big-end bearings	Nm 54 + 90° N	34 + 120° N	34 + 120° N	29 + 90° N
Main bearings	Nm 103	103	100	49 + 90°
Crankshaft pulley bolt	Nm 167	167	167	363
Camshaft pulley bolt	Nm 98	98	98	98
Flywheel [driveplate] bolt	Nm 114 to 122	123	123	145
Front hubs	Nm WSM	WSM	WSM	WSM
Rear hubs	Nm WSM	WSM	WSM	WSM
Wheel nuts / bolts	Nm 103	100	100	103
Glow plugs	Nm 13	13	10 to 15	13
Clutch pressure plate bolts	Nm 19	19	20	19
Injection pump sprocket	Nm 64	64	64	64
Injectors	Nm 69	64	64	64
Injection pump mounting bolts	Nm -	18	-	21
Injector pipe unions	Nm 25	25	-	15
Capacities				
Engine oil & filter	litres 5.8	5.8	6.5	8.0
Gearbox	litres G52, 58: 3.9 ²	3.9	3.9	Transfer: 1.1
Automatic transmission	litres -	-	-	-
Final drive	litres Front: 2.3 ³	1.8	2.0 Rear: 2.2	1.6 Rear: 2.2
Cooling system	litres 9.3	9.7	9.7	11.0
Fuel tank	litres 65	69	77 Double Cab: 66	65

Notes

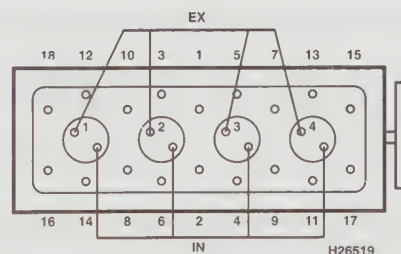
Hi-Lux 2.4 4x4 (LN105) 1988 to 1996

¹With automatic cold starting device: 0.82 to 0.98

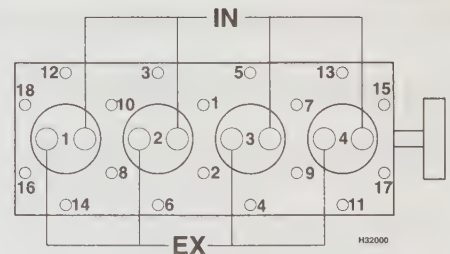
²W56: 3.0. Transfer box: 1.6. Planetary type: 1.1

³Rear: 2.2

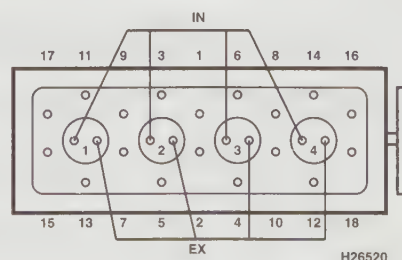
⁴Shank diameter: ≥11.6 mm



2446 cm³ (4x4)



2446 cm³



2982 cm³

- Not applicable, or information not available



TOYOTA

Hi-Ace 2.4 (LH112) 1989 to 1996

Engine				
Engine type/code.....	2L SOHC 56kW			
Capacity (cm ³) / cylinders.....	2446 / 4			
Compression ratio / pressure.....bar	22.2 / ≥20.0			
Torque output.....Nm	162			
Oil pressure.....idle [running] bar	[2.5 to 5.9 @ 3000]			
Oil temperature.....°C	80			
Valve clearances - inlet (mm).....	0.20 to 0.30			
- exhaust (mm).....	0.25 to 0.35			
Injection order.....	1-3-4-2			
No. 1 cylinder position.....	F			
Cooling system				
Thermostat opening temperature.....°C	86 to 90			
Radiator cap pressure.....bar	0.7 to 1.0			
Fuel system				
Idle speed.....rpm	700			
Maximum (no load) speed.....rpm	4900			
Smoke test/opacity.....M ⁻¹ %	2.5			
Static timing method.....	Plunger travel			
Timing dimension.....mm	0.54 to 0.66			
Crankshaft position.....mm [°]	[0] TDC			
Turbo type / ref / pressure.....bar	-			
Injection pump make.....	-			
Injection pump part no.....	-			
Injector Make / type.....	Nippon Denso			
Injector part no.....	DN-DN4SDND 133			
Injection type.....	-			
Injection opening pressure, New [used]...bar	146 to 155 [140]			
Glow plugs				
Maker.....	Bosch/Champion			
Type.....	0250 202 053 / CH103			
Nominal rating.....V/A	-			
Brakes				
minimum friction material thickness				
Front.....mm	1.0			
Rear.....mm	1.0			
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185x14			
Pressure - front / rear - Saloon / Hatch...bar	-			
- Estate / Van.....bar	3.0 / 4.5			
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 ± 1.0			
Camber.....	-10' ± 30'			
Castor.....	1°40' ± 30'			
King pin inclination.....	10°40' ± 30'			
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-			
Camber.....	-			



TOYOTA

Hi-Ace 2.4 (LH112)
1989 to 1996

Torque wrench settings

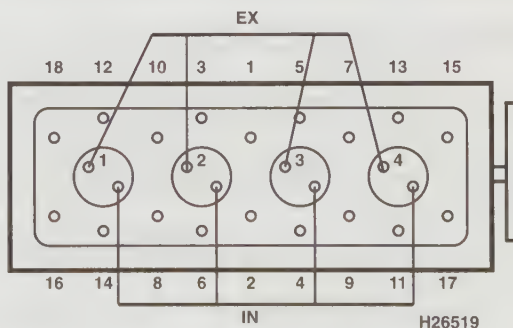
Cylinder head - stage 1	Nm	78 ¹
- stage 2	Nm	+ 90°
- stage 3	Nm	+ 90°
- stage 4	Nm	-
- stage 5	Nm	-
- stage 6	Nm	-
Big-end bearings	Nm	54 + 90° N
Main bearings	Nm	103
Crankshaft pulley bolt	Nm	167
Camshaft pulley bolt	Nm	98
Flywheel [driveplate] bolt	Nm	114 to 122
Front hubs	Nm	WSM
Rear hubs	Nm	WSM
Wheel nuts / bolts	Nm	103
Glow plugs	Nm	13
Clutch pressure plate bolts	Nm	19
Injection pump sprocket	Nm	64
Injectors	Nm	69
Injection pump mounting bolts	Nm	-
Injector pipe unions	Nm	25

Capacities

Engine oil & filter	litres	6.7
Gearbox	litres	2.2
Automatic transmission	litres	-
Final drive	litres	2.2
Cooling system	litres	10.6
Fuel tank	litres	70

Notes

Hi-Ace 2.4 (LH112) 1989 to 1996
¹Shank diameter: ≥11.6 mm

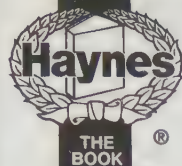


- Not applicable, or information not available



VAUXHALL/OPEL

	Nova / Corsa 1.5 1989 to 1993	Nova / Corsa 1.5 Turbo 1989 to 1993	Corsa-B 1.5 D 1993 to 1996	Corsa-B 1.5 TD 1993 to 1996
Engine				
Engine type/code.....	15D SOHC 37kW	15DT SOHC Turbo 49kW	15D SOHC 37kW	X15DT SOHC 49kW
Capacity (cm ³) / cylinders.....	1488 / 4	1488 / 4	1488 / 4	1488 / 4
Compression ratio / pressure.....bar	23.0 / ≥22.0	22.5 / ≥22.0	23.0 / ≥22.0	22.0 / _
Torque outputNm	90	132	90	132
Oil pressureidle [running] bar	1.5	1.5	1.5	2.0
Oil temperature°C	80	80	≥80	80
Valve clearances - inlet (mm).....	0.15	0.15	0.15	0.15
- exhaust (mm).....	0.25	0.25	0.25	0.25
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	88	88	88 to 106	88 to 106
Radiator cap pressurebar	1.2 to 1.5	1.2 to 1.5	1.2 to 1.4	1.2 to 1.4
Fuel system				
Idle speedrpm	780 to 840	800 to 900	830 to 930	830 to 990 N/A
Maximum (no load) speedrpm	5600 to 5800	5400 to 5600	5800	5600
Smoke test/opacityM ⁻¹ %	2.5	2.5	3.0	2.5
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	0.90 ± 0.05	0.68 ± 0.05	0.90 ± 0.05	0.68 ± 0.05
Crankshaft positionmm [°]	[0] TDC	[0] TDC	0 TDC	0 TDC
Turbo type / ref / pressure.....bar	-	0.68 bar @ 5600rpm	-	0.68 bar @ 5600
Injection pump make.....	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	9 460 620 001	9 460 620 002	VE R3284	VE R305
Injector Make / type.....	2 jet	2 jet	Bosch	Bosch
Injector part no.....	NP-DN OPD N108	NP-DN OPD N108	NP DNOPDN 108	NP DNOPDN 108
Injection type.....	VER 284	VER 305	Indirect VE 4	Indirect VE
Injection opening pressure, New [used]...bar	142 to 162	142 to 162	142 to 162	142 to 162
Glow plugs				
Maker.....	Bosch	Bosch/Champion	Bosch	Bosch
Type.....	0250 202 008	0250 202 008 / CH158	0250 202 008	0250 202 008
Nominal rating.....V/A	5 / 11	5.0 / 11	5 / 12.5	5 / 12.5
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	7.0 with backing
Rear.....mm	0.5 above rivets	0.5 above rivets	0.5 above rivets	0.5 above rivets
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	145x13: 165/65x14: 165/70x13	145x13: 165/65x14: 165/70x13	145x13	165/70x13: 165/65x14
Pressure - front / rear - Saloon / Hatch...bar	1.9 / 1.7	1.9 / 1.7'	2.1 / 1.9	2.2 / 2.0
- Estate / Vanbar	1.9 / 1.7	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.5 to 0.5	-1.5 to 0.5	[-0°10' ± 10']	[-0°10' ± 10']
Camber.....	-45' to 45' L	-45' to 45' L	-0°35 ± 45'	-0°25 ± 45'
Castor.....	45' to 2°45' L	45' to 2°45' L	1°50' ± 1°	1°50' ± 1°
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-0.5 to 4.0	-0.5 to 4.0	[0°10' +30' -15']	[0°10' +30' -15']
Camber.....	-40' to -1°35'	-40' to -1°35'	-1°30' ± 30'	-1°30' ± 30'

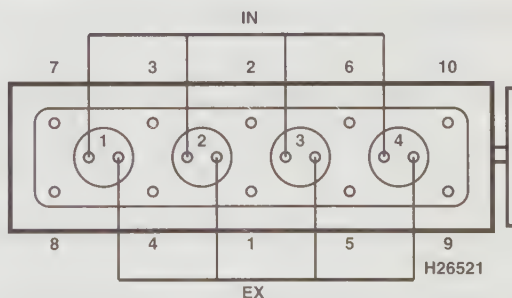


VAUXHALL/OPEL

	Nova / Corsa 1.5 1989 to 1993	Nova / Corsa 1.5 Turbo 1989 to 1993	Corsa-B 1.5 D 1993 to 1996	Corsa-B 1.5 TD 1993 to 1996
Torque wrench settings				
Cylinder head - stage 1.....Nm	40 N	40 N	40 N	40 N
- stage 2.....Nm	+ 60 to 75°	+ 60 to 75°	+ 60°	+ 60°
- stage 3.....Nm	+ 60 to 75°	+ 60 to 75°	+ 60°	+ 60°
- stage 4.....Nm	-	-	+ 60°	+ 60°
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	25 + 45 to 60° N	25 + 45 to 60° N	25 + 60° N	30 + 60° N
Main bearings.....Nm	88	88	88	90
Crankshaft pulley bolt.....Nm	133 to 161	133 to 161	161	161
Camshaft pulley bolt.....Nm	10	10	10	10
Flywheel [driveplate] bolt.....Nm	30 + 45 to 60°	30 + 45 to 60°	30 + 60° N	35 + 30° + 15° N
Front hubs.....Nm	100, slacken, 20 + 90°	100, slacken, 20 + 90°	100, slacken, 20 + 90°	100, slacken, 20 + 90°
Rear hubs.....Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	90	90	110	110
Glow plugs.....Nm	20	20	20	25
Clutch pressure plate bolts.....Nm	15	15	15	15
Injection pump sprocket.....Nm	64	64	64	64
Injectors.....Nm	50	50	50	50
Injection pump mounting bolts.....Nm	25	25	40	40
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	3.75	3.75	3.75	3.7
Gearbox.....litres	1.8	1.8	1.6	1.6
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	6.4	6.4	6.0	6.3
Fuel tank.....litres	42	42	46	46

Notes

Nova / Corsa 1.5 Turbo 1989 to 1993
 '145x13: 2.0 / 1.8



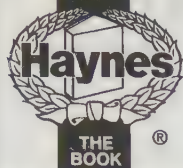
1488 cm³

- Not applicable, or information not available



VAUXHALL/OPEL

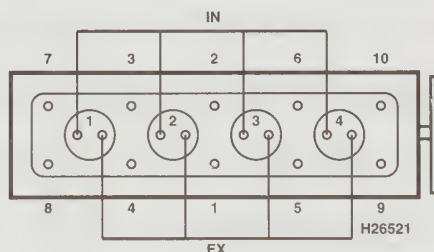
	Corsa-B 1.5 TD 1996 to 2000	Corsa-B & Combo 1.7 D 1996 to 2000	Astra-F 1.7 D 1991 to 1994	Astra-F 1.7 D 1991 to 1994
Engine				
Engine type/code	X15DT SOHC 49kW	X17D SOHC 44kW	17D SOHC 42kW	17D SOHC 42kW
Capacity (cm ³) / cylinders	1488 / 4	1686 / 4	1699 / 4	1699 / 4
Compression ration / pressurebar	22.0 / _	23.0 / _	23.0 / ≥18.5	23.0 / ≥18.5
Torque outputNm	132	112	0	0
Oil pressureidle [running] bar	1.5	2.0	1.5	1.5
Oil temperature°C	≥80	≥80	80	80
Valve clearances - inlet (mm)	0.15	0.15	0: Hyd.	0: Hyd.
- exhaust (mm)	0.25	0.25	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	88 to 106	88	86	86
Radiator cap pressurebar	1.2 to 1.4	1.2 to 1.4	1.4 to 1.5	1.4 to 1.5
Fuel system				
Idle speedrpm	830 to 930	830 to 930	820 to 920	820 to 920
Maximum (no load) speedrpm	5600	5300	5600	5600
Smoke test/opacityM ⁻¹ %	2.5	2.5	3.0	3.0
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	0.68 ± 0.05	0.65 ± 0.05	0.80 to 0.85	Dimension on pump
Crankshaft positionmm [°]	0 TDC	0 TDC	0 TDC	-
Turbo type / ref / pressurebar	0.68 bar @ 5600	-	-	-
Injection pump make	Bosch	Bosch	Bosch	Lucas
Injection pump part no.....	VE R305	VE 4R554	VE 4/9 R4433	DPC R8443 B550A
Injector Make / type	2 jet	-	Bosch	CAV
Injector part no.....	NP DNOPDN 108	DNOPDN108	DNOSD309	BDNOSDC6751C
Injection type.....	Indirect VE 4	Indirect VE 4	Indirect VE4	Indirect DPC
Injection opening pressure, New [used]...bar	142 to 162	142 to 162	135 to 143 [130]	135 to 143 [130]
Glow plugs				
Maker	Champion	-	Bosch/Champion	Bosch/Champion
Type	CH158	-	0250 201 019 / CH68	0250 201 019 / CH68
Nominal ratingV/A	11 / 5	11 / 5	5 / 12.5	5 / 12.5
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	7.0 with backing
Rear.....mm	0.5 above rivets	0.5 above rivets	0.5 above rivets	0.5 above rivets
Tyres - Saloon / HatchSize	165/70x13: 165/65x14	165/70x13: 165/65x14	175/65x14	175/65x14
- Estate / Van.....Size	-	165/70x13: 175/65x14	175/65x14	175/65x14
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.0	2.2 / 2.0	2.1 / 1.8	2.1 / 1.8
- Estate / Vanbar	-	2.2 / 2.0: 2.2 / 2.2	2.2 / 2.0	2.2 / 2.0
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[-0°10' ± 10']	0.5 ± 1.0 L	-2.5 to -0.5 L	-2.5 to -0.5 L
Camber	-0°25' ± 45'	-35' ± 45' L	-1°5' ± 45'	-1°5' ± 45'
Castor	1°50' ± 1°	1°50' ± 1° L	2°15' ± 1°	2°15' ± 1°
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°10' +30' -15']	1.0 +3.0 -1.5	-1.0 ± 4.0	-1.0 ± 4.0
Camber	-1°30' ± 30'	-1°30' ± 30' L	-1°40' ± 30'	-1°40' ± 30'



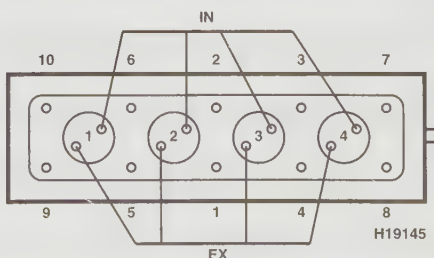
VAUXHALL/OPEL

	Corsa-B 1.5 TD 1996 to 2000	Corsa-B & Combo 1.7 D 1996 to 2000	Astra-F 1.7 D 1991 to 1994	Astra-F 1.7 D 1991 to 1994
Torque wrench settings				
Cylinder head - stage 1.....Nm	40 N	40 N	25 N	25 N
- stage 2.....Nm	+ 60°	+ 60° to 75°	+ 60°	+ 60°
- stage 3.....Nm	+ 60°	+ 60° to 75°	+ 60°	+ 60°
- stage 4.....Nm	+ 60°	-	+ 60°	+ 60°
- stage 5.....Nm	-	-	Warm up	Warm up
- stage 6.....Nm	-	-	+ 45°	+ 45°
Big-end bearings.....Nm	25 + 60° N	25 + 100° + 15° N	35 + 45° N	35 + 45° N
Main bearings.....Nm	90 N	88	50 + 45° N	50 + 45° N
Crankshaft pulley bolt.....Nm	161	133 to 161 N	145 + 30° + 10° N	145 + 30° + 10° N
Camshaft pulley bolt.....Nm	10	75 + 60° N	75 + 60° N	75 + 60° N
Flywheel [driveplate] bolt.....Nm	35 + 30° + 15° N	38 + 45° to 60° N	50 + 30° N	50 + 30° N
Front hubs.....Nm	100, slacken, 20 + 90°	100, slacken, 20 + 90°	100, slacken, 20 + 90°	100, slacken, 20 + 90°
Rear hubs.....Nm	WSM	WSM	-	-
Wheel nuts / bolts.....Nm	110	110	110	110
Glow plugs.....Nm	20	20	20	20
Clutch pressure plate bolts.....Nm	15	15	15	15
Injection pump sprocket.....Nm	64	64	25	25
Injectors.....Nm	50	50	70	70
Injection pump mounting bolts.....Nm	45	45	23	23
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	4.25	4.25	5.0	5.0
Gearbox.....litres	1.6	1.6	1.6	1.6
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	6.3	6.0	6.8	6.8
Fuel tank.....litres	46	46 Combo: 50	52 Estate: 50	52 Estate: 50

Notes



1488 cm³



1686 cm³ / 1699 cm³

- Not applicable, or information not available



VAUXHALL/OPEL

	Astra-F 1.7 D 1992 to 1996	Astra-F 1.7 D 1992 to 1996	Astra-F 1.7 TD 1991 to 1998	Astra-F 1.7 TD 1994 to 1998
Engine				
Engine type/code.....	17DR SOHC EGR 44kW	17DR SOHC EGR 44kW	17DT SOHC Turbo 60kW	X17DTL SOHC Turbo 50kW ¹
Capacity (cm ³) / cylinders.....	1699 / 4	1699 / 4	1686 / 4	1699 / 4
Compression ratio / pressure.....bar	23.0 / ≥18.5	23.0 / ≥18.5	22.0 / ≥18.5	23.0 / ≥18.5
Torque output.....Nm	0	0	168	132
Oil pressure.....idle [running] bar	1.5	1.5	1.5	1.5
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0: Hyd.	0: Hyd.	0.15	0: Hyd.
- exhaust (mm).....	0: Hyd.	0: Hyd.	0.25	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature.....°C	86	86	86	88
Radiator cap pressure.....bar	1.4 to 1.5	1.4 to 1.5	1.4 to 1.5	1.4 to 1.5
Fuel system				
Idle speed.....rpm	820 to 920	820 to 920	780 to 880	820 to 920
Maximum (no load) speed.....rpm	5600	5600	5100 to 5300	5600
Smoke test/opacity.....M ⁻¹ %	3.0	3.0	3.0	3.0
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	Dimension on pump	0.85 to 0.9	0.55	0.85 to 0.90
Crankshaft position.....mm [°]	—	0 TDC	0 TDC	0 TDC
Turbo type / ref / pressure.....bar	—	—	0.72 bar @ 4400rpm	—
Injection pump make.....	Lucas	Bosch	Bosch	Bosch
Injection pump part no.....	DPC R8443 B850C	VER 487	9460 620 007	VER 571
Injector Make / type.....	CAV	Bosch	—	Bosch
Injector part no.....	BDNOSDC6751D	DNOSD 309	NPDNOPDN122	DNOSD 309
Injection type.....	Indirect DPC	Indirect VER	Indirect VE4	Indirect VER
Injection opening pressure, New [used]...bar	135 to 143 [130]	135 to 143 [130]	142 to 162 [142]	135 to 142 [130]
Glow plugs				
Maker.....	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type.....	0250 202 087 / CH158	0250 202 087 / CH158	0250 202 087 / CH158	0250 202 087 / CH158
Nominal rating.....V/A	5 / 12.5	5 / 12.5	11 / 12.2	5 / 12.5
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	7.0 with backing
Rear.....mm	0.5 above rivets	0.5 above rivets	0.5 above rivets	0.5 above rivets
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175/65x14	175/65x14	175/65x14	155/80x13: 175/65x14
Pressure - front / rear - Saloon / Hatch...bar	2.1 / 1.8	2.1 / 1.8	2.1 / 1.8	2.0 / 1.7
- Estate / Van.....bar	2.2 / 2.0	2.2 / 2.0	2.2 / 2.0	2.0 / 1.8
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-2.5 to -0.5 L	-2.5 to -0.5 L	-2.5 to -0.5 L	[-0°15' ± 10°]
Camber.....	-1°5' ± 45'	-1°5' ± 45'	-1°5' ± 45'	-1°5' ± 45'
Castor.....	2°15' ± 1°	2°15' ± 1°	2°15' ± 1°	2°15' ± 1° Est: 1°30' ± 1°
King pin inclination.....	—	—	—	—
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.0 ± 4.0	-1.0 ± 4.0	-1.0 ± 4.0	[0°10' ± 30°]
Camber.....	-1°40' ± 30'	-1°40' ± 30'	-1°40' ± 30'	-1°40' ± 30'



VAUXHALL/OPEL

	Astra-F 1.7 D 1992 to 1996	Astra-F 1.7 D 1992 to 1996	Astra-F 1.7 TD 1991 to 1998	Astra-F 1.7 TD 1994 to 1998
Torque wrench settings				
Cylinder head - stage 1Nm	25 N	25 N	40 N	25
- stage 2Nm	+ 90°	+ 90°	+ 75°	+ 90°
- stage 3Nm	+ 90°	+ 90°	+ 75°	+ 90°
- stage 4Nm	+ 45°	+ 45°	-	+ 45°
- stage 5Nm	Warm up	Warm up	-	warm up
- stage 6Nm	+ 45°	+ 45°	-	+ 45°
Big-end bearings.....Nm	35 + 45° + 15° N	35 + 45° + 15° N	25 + 100° + 15° N	35 + 45° + 15° N
Main bearings.....Nm	50 + 45° + 15° N	50 + 45° + 15° N	88	50 + 45° + 15° N
Crankshaft pulley boltNm	145 + 30° + 10° N	145 + 30° + 10° N	161	145 + 30° + 10° N
Camshaft pulley boltNm	75 + 60° N	75 + 60° N	10	75 + 60° + 5° N
Flywheel [driveplate] bolt.....Nm	50 + 30° N	50 + 30° N	30 + 60° N	50 + 30° + 15° N
Front hubsNm	100, slacken, 20 + 90°	100, slacken, 20 + 90°	100, slacken, 20 + 90°	100, slacken, 20 + 90°
Rear hubsNm	-	-	-	50 + 45° N
Wheel nuts / boltsNm	110	110	110	110
Glow plugsNm	20	20	20	20
Clutch pressure plate boltsNm	15	15	15	15
Injection pump sprocket.....Nm	25	25	69	25
Injectors.....Nm	70	70	50	70
Injection pump mounting boltsNm	23	23	23	25
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	5.0	5.0	4.8	4.5
Gearbox.....litres	1.6	1.6	1.6	1.9
Automatic transmissionlitres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	6.8	6.8	6.8	6.8
Fuel tank.....litres	52 Estate: 50	52 Estate: 50	52 Estate: 50	52 Estate: 50
Notes				
<p>Astra-F 1.7 TD 1994 to 1998</p> <p>¹Low pressure turbo</p>				
<p>1686 cm³</p> <p>1699 cm³</p>				
- Not applicable, or information not available				



VAUXHALL/OPEL

	Astra-F 1.7 TD 1994 to 1998	Astra-F 1.7 TD 1994 to 1998	Astra-G 1.7 TD 1998 to 2000	Astra-G 2.0 TDi 16V 1998 to 2000
Engine				
Engine type/code	X17DTL SOHC Turbo 50kW	X17DT SOHC Turbo 60kW	X17DTL SOHC Turbo 50kW	X20DTL SOHC 16V Turbo 60kW
Capacity (cm ³) / cylinders	1699 / 4	1686 / 4	1699 / 4	1995 / 4
Compression ratio / pressure	23.0 / ≥18.5	22.0 / ≥18.5	22.0 / _	18.5 / _
Torque output	132	168	132	185
Oil pressureidle [running] bar	1.5	2.0	1.5	1.5
Oil temperature°C	80	80	≥80	≥80
Valve clearances - inlet (mm)	0: Hyd.	0.15	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0.25	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	88	86	92	92
Radiator cap pressurebar	1.4 to 1.5	1.4 to 1.5	1.2 to 1.5	1.2 to 1.5
Fuel system				
Idle speedrpm	820 to 920	780 to 880	950 to 100	820 to 890
Maximum (no load) speedrpm	5600	5100 to 5300	5400 to 5500	4750
Smoke test/opacityM ⁻¹ %	3.0	3.0	3.0	2.0
Static timing method	Plunger travel	Plunger travel	-	-
Timing dimension.....mm	Dimension on pump	0.55	Computer controlled	-
Crankshaft positionmm [°]	-	0 TDC	-	-
Turbo type / ref / pressurebar	-	0.72 bar @ 4400rpm	-	-
Injection pump make	Lucas	Bosch	Bosch	Bosch
Injection pump part no.....	R8443 B850C	VER 487	VP 29	VP 44
Injector Make / type	CAV	Bosch	-	-
Injector part no.....	-	DNOSD 309	-	-
Injection type.....	Indirect DPC	Indirect VE4	Indirect EDC15M	Direct injection EDC 15M
Injection opening pressure, New [used]...bar	135 to 142 [130]	142 to 162 [142]	132 to 145	180 to 365
Glow plugs				
Maker	Bosch/Champion	Bosch/Champion	-	Champion
Type	0250 202 087 / CH158	0250 202 087 / CH68	-	CH207
Nominal rating	5 / 12.5	11 / 12.2	-	11 /
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	7.0 with backing
Rear.....mm	0.5 above rivets	0.5 above rivets	0.5 above rivets	7.0 with backing
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	155/80x13: 175/65x14	175/65x14	175/70x14: 195/60x15	195/60x15: 185/65x14
Pressure - front / rear - Saloon / Hatch...bar	2.0 / 1.7	2.1 / 1.8	2.2 / 1.9: 2.2 / 1.9	2.4 / 2.1: 2.4 / 2.1
- Estate / Vanbar	2.0 / 1.8	2.2 / 2.0	2.2 / 2.0: 2.2 / 2.0	2.4 / 2.2
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[-0°15' ± 10']	[-0°15' ± 10']	-2.5 to -0.5 L	[0°10' ± 10']
Camber	-1°5' ± 45'	-1°5' ± 45'	-1°5' ± 45'	-1°10' ± 45'
Castor	2°15' ± 1° Est: 1°30' ± 1°	2°15' ± 1° Est: 1°30' ± 1°	2°15' ± 1°	4° ± 1°
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°10' ± 30']	[0°10' ± 30']	-1.0 to 4.0	[0°10' ± 30' - 20']
Camber	-1°40' ± 30'	-1°40' ± 30'	-1°40' ± 30'	1°40' ± 30'



VAUXHALL/OPEL

	Astra-F 1.7 TD 1994 to 1998	Astra-F 1.7 TD 1994 to 1998	Astra-G 1.7 TD 1998 to 2000	Astra-G 2.0 TDi 16V 1998 to 2000
Torque wrench settings				
Cylinder head - stage 1	25	40 N	25 N	25 N
- stage 2	+ 90°	+ 75°	+ 90°	+ 65°
- stage 3	+ 90°	+ 75°	+ 90°	+ 65°
- stage 4	+ 45°	-	+ 45°	+ 65°
- stage 5	warm up	-	Warm-up	+ 65°
- stage 6	+ 45°	-	+ 45°	+ 15°
Big-end bearings	35 + 45° + 15° N	25 + 100° + 15° N	35 + 45° + 15° N	30 + 45° + 15° N
Main bearings	50 + 45° + 15° N	88	50 + 45° + 15° N	90 + 60° + 15° N
Crankshaft pulley bolt	145 + 30° + 10° N	161	130 + 45° ± 5° N	150 + 45° + 15° N
Camshaft pulley bolt	75 + 60° + 5° N	10	70 + 60° + 5° N	90 + 60° + 30° N
Flywheel [driveplate] bolt	50 + 30° + 15° N	30 + 60° N	65 + 30° + 15° N	40 + 30° + 15° N
Front hubs	100, slacken, 20 + 90°	100, slacken, 20 + 90°	WSM	WSM
Rear hubs	50 + 45° N	50 + 45° N	WSM	50 + 30° N
Wheel nuts / bolts	110	110	110	110
Glow plugs	20	20	20	10
Clutch pressure plate bolts	15	15	15	15
Injection pump sprocket	25	69	-	20
Injectors	70	50	70	WSM
Injection pump mounting bolts	25	23	-	25
Injector pipe unions	25	25	-	30
Capacities				
Engine oil & filter	4.5	4.8	5.5	5.5
Gearbox	1.9	1.9	1.6	1.8
Automatic transmission	-	-	-	4.0
Final drive	WT	WT	WT	WT
Cooling system	6.8	6.8	8.7	7.9
Fuel tank	52 Estate: 50	52 Estate: 50	52 Estate: 50	52 Estate: 50

Notes

Astra-F 1.7 TD 1994 to 1998

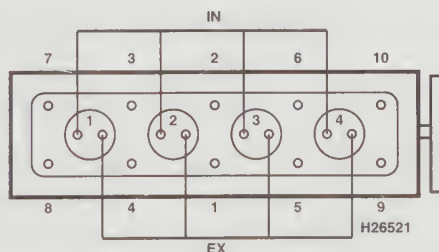
'Low pressure turbo

Astra-G 1.7 TD 1998 to 2000

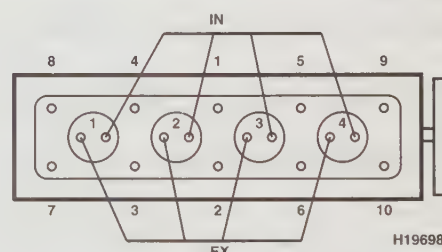
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Astra-G 2.0 TDi 16V 1998 to 2000

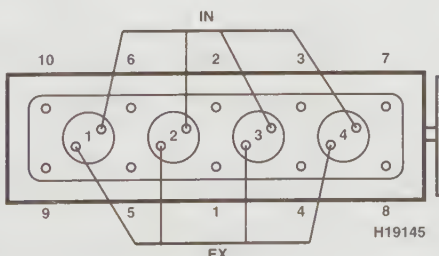
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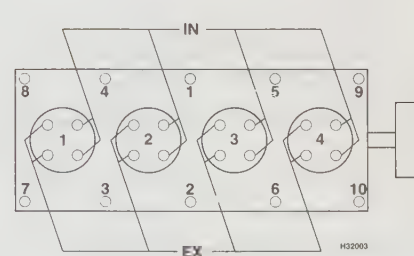
1686 cm³



1700 cm³

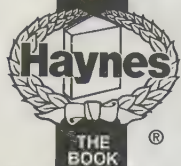


1699 cm³



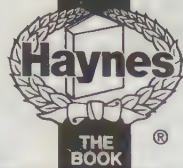
1994 cm³ 16V

- Not applicable, or information not available



VAUXHALL/OPEL

	Kadett/Astra/Belmont 1.5TD 1990 to 1991	Kadett/Astra/Belmont 1.7 1989 to 1991	Kadett/Astra/Belmont 1.7 1989 to 1991	Zafira 2.0 Di 1999 to 2000
Engine				
Engine type/code.....	15DTR SOHC 53kW	17D 42kW	17D 42kW	X20DTL SOHC 16V 60kW
Capacity (cm ³) / cylinders.....	1488 / 4	1699 / 4	1699 / 4	1995 / 4
Compression ratio / pressure.....bar	22.0 / _	23.0 / _	23.0 / _	18.5 / 25 to 28
Torque outputNm	0	0	0	185
Oil pressureidle [running] bar	1.5	1.0	1.0	1.5
Oil temperature°C	60	60	60	80
Valve clearances - inlet (mm).....	0.15	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm).....	0.25	0: Hyd.	0: Hyd.	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TCE
Cooling system				
Thermostat opening temperature.....°C	88	92	92	92
Radiator cap pressure.....bar	1.2 to 1.5	1.2 to 1.5	1.2 to 1.5	-
Fuel system				
Idle speedrpm	780 to 840	820 to 880	820 to 880	760 to 860
Maximum (no load) speedrpm	5400 to 5600	5600-100	5600-100	4750
Smoke test/opacityM ⁻¹ %	2.5	2.5	2.5	1.9
Static timing method.....	Dial gauge	Plunger travel	Plunger travel	Refer to wsm
Timing dimension.....mm	0.68	0.8 ± 0.05	X-0.15'	Computer controlled
Crankshaft position.....mm [°]	TDC	TDC	TDC	-
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	Bosch	Bosch	CAV.	Bosch
Injection pump part no.....	8 944 608 050	F 2300 R313 [R313-1]	-	VP44
Injector Make / type.....	2 jet	Bosch	CAV	-
Injector part no.....	NP-DN OPD N108	DN OSD 292	BDN or RDN OSD C6751	-
Injection type.....	VER 305	VE 4/9	DPC OP02	Direct EDC 15M
Injection opening pressure, New [used]...bar	142 to 162	135 to 143	130 to 138	180 to 365
Glow plugs				
Maker.....	Champion	Bosch/Champion	Bosch/Champion	-
Type.....	12 14 309 / CH110	90 201 005 / CH68	90 201 005 / CH68	-
Nominal rating.....V/A	5 / _	11 / 8	11 / 8	-
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	8.0 with backing
Rear.....mm	0.5 above rivets	0.5 above rivets	0.5 above rivets	8.0 with backing
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	155x13: 165x13: 175/70x13 ²	155x13: 165x13: 175/70x13 ¹	155x13: 165x13: 175/70x13 ²	-
Pressure - front / rear - Saloon / Hatch...bar	1.8 / 1.6 ³	1.8 / 1.6 ³	1.8 / 1.6 ⁴	195/65x15
- Estate / Van.....bar	1.9 / 1.9	1.9 / 1.9 ⁴	1.9 / 1.9 ⁵	2.2 / 2.2
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-2.0 to 0 L	-2.0 to 0 L	-2.0 to 0 L	[0° ± 10°] L
Camber.....	-1°15' to 15'	-1°15' to 15'	-1°15' to 15'	-1°10' ± 45'
Castor.....	45° to 2°45'. Est: 0 to 2°	45° to 2°45'. Est: 0 to 2°	45° to 2°45'. Est: 0 to 2°	3° ± 1°
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[-10° to 40°]	[-10° to 40°]	[-10° to 40°]	[0°10' +30° -20°] L
Camber.....	-30° ± 30°	-30° ± 30°	-30° ± 30°	-1°40' ± 30°



VAUXHALL/OPEL

	Kadett/Astra/Belmont 1.5TD 1990 to 1991	Kadett/Astra/Belmont 1.7 1989 to 1991	Kadett/Astra/Belmont 1.7 1989 to 1991	Zafira 2.0 Di 1999 to 2000
Torque wrench settings				
Cylinder head - stage 1.....Nm	40	25	25	25 N
- stage 2.....Nm	+ 60 to 75°	+ 60°	+ 60°	+ 65°
- stage 3.....Nm	-	+ 60°	+ 60°	+ 65°
- stage 4.....Nm	-	+ 60°	+ 60°	+ 65°
- stage 5.....Nm	-	Warm up, + 45°	Warm up, + 45°	+ 65°
- stage 6.....Nm	-	-	-	+ 15°
Big-end bearings.....Nm	25 + 45 to 60°	35	35	35 + 45° + 15° N
Main bearings.....Nm	84 to 93	50	50	90 + 60° + 15° N
Crankshaft pulley bolt.....Nm	133 to 161	130 + 45+5°	130 + 45+5°	150 + 45° + 15° N
Camshaft pulley bolt.....Nm	8 to 11	75 + 60 to 65°	75 + 60 to 65°	90 + 60° + 30° N
Flywheel [driveplate] bolt.....Nm	30 + 45 to 60°	50 + 30 to 45°	50 + 30 to 45°	45 + 30° + 15° N
Front hubs.....Nm	WSM	WSM	WSM	120, slacken, 20 + 90° N
Rear hubs.....Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	90	90	90	110
Glow plugs.....Nm	20	20	20	10
Clutch pressure plate bolts.....Nm	15	15	15	15
Injection pump sprocket.....Nm	70	22	22	28
Injectors.....Nm	50	70	70	WSM
Injection pump mounting bolts.....Nm	45	25	25	25
Injector pipe unions.....Nm	-	-	-	30
Capacities				
Engine oil & filter.....litres	4.5	4.75	4.75	5.5
Gearbox.....litres	1.8	2.1	2.1	1.9
Automatic transmission.....litres	-	6.3	6.3	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	6.3	9.1	9.1	7.9
Fuel tank.....litres	52. Est/Van: 50	52. Est/van: 50	52. Est/van: 50	58

Notes

Kadett/Astra/Belmont 1.5TD 1990 to 1991

²Also 175/65x14

³175/65X14: 2.1 / 1.9

Kadett/Astra/Belmont 1.7 1989 to 1991

¹Also 175/65x14: 185/60x14

²Also 165x14: 175/65x14

³185/60x14: 1.7 / 1.7. 90 ▶: 175/65x14: 2.1 / 1.9

⁴165x13, 165x14: 1.8 / 1.8. 90 ▶: 1.9 / 1.9. Astramax: 1.8 / 2.2

Kadett/Astra/Belmont 1.7 1989 to 1991

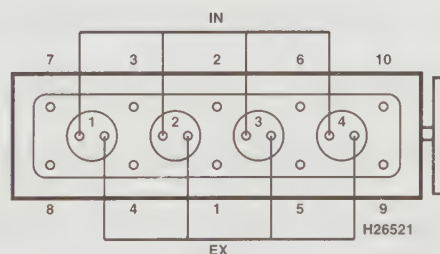
¹Where X = value shown on pump lever

²Also 175/65x14: 185/60x14

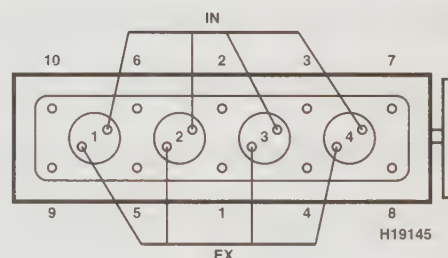
³Also 165x14: 175/65x14

⁴185/60x14: 1.7 / 1.7. 90 ▶: 175/65x14: 2.1 / 1.9

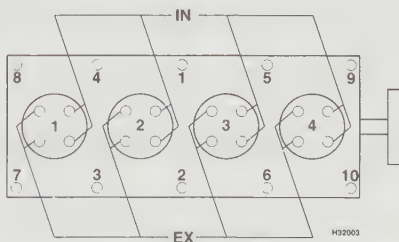
⁵165x13, 165x14: 1.8 / 1.8. 90 ▶: 1.9 / 1.9. Astramax: 1.8 / 2.2



1488 cm³



1699 cm³



1995 cm³

- Not applicable, or information not available



VAUXHALL/OPEL

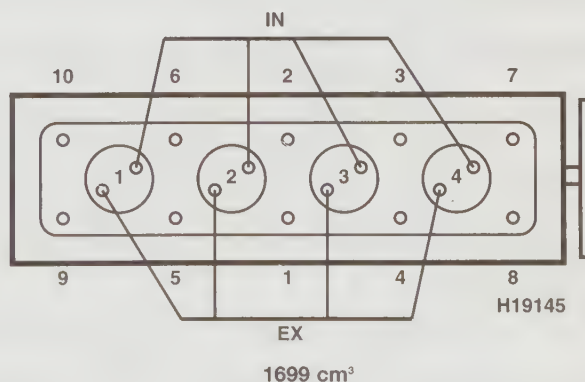
	Cavalier/Vectra 1.7 D 1988 to 1992	Cavalier/Vectra 1.7 D 1988 to 1992	Cavalier/Vectra 1.7 D 1993 to 1995	Cavalier/Vectra 1.7 D 1993 to 1995
Engine				
Engine type/code.....	17D SOHC 42kW	17D SOHC 42kW	17DR SOHC 44kW	17DR SOHC 44kW
Capacity (cm ³) / cylinders.....	1699 / 4	1699 / 4	1699 / 4	1699 / 4
Compression ratio / pressurebar	23.0 / _	23.0 / _	23.0 / ≥19.0	23.0 / ≥19.0
Torque outputNm	0	0	105	105
Oil pressureidle [running] bar	1.8	1.5	1.5	1.5
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	92	92	92	92
Radiator cap pressurebar	1.20 to 1.35	1.20 to 1.35	1.20 to 1.35	1.20 to 1.35
Fuel system				
Idle speedrpm	820 to 920	820 to 920	820 to 920	820 to 920
Maximum (no load) speedrpm	5600	5600	5600	5600
Smoke test/opacityM ⁻¹ %	3.0	3.0	3.0	3.0
Static timing method.....	Plunger travel	Refer to wsm	Plunger travel	Plunger travel
Timing dimension.....mm	0.80 to 0.85	Dimension on pump	0.80 to 0.85	Dimension on pump
Crankshaft positionmm [°]	0 TDC	-	0 TDC	-
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make	Bosch	CAV	Bosch	Lucas
Injection pump part no.....	VE 4/9 R443	R8442 B55 0A	VE 4/9	R8443 B850A
Injector Make / type.....	Bosch	CAV	Bosch	CAV
Injector part no.....	0432 217 197	BDN OSDC 6751C	DNOSD 309	BDNOSD C6751C
Injection type.....	Indirect VE 4/9	Indirect DPC	Indirect VE 4/9	Indirect DPC
Injection opening pressure, New [used]...bar	135 to 143 [130 to 138]	135 to 143 [130 to 138]	135 to 143 [130 to 138]	135 to 143 [130 to 138]
Glow plugs				
Maker	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type	0250 201 019 / CH68	0250 201 019 / CH68	0250 201 019 / CH68	0250 201 019 / CH68
Nominal rating.....V/A	11 / 12	11 / 12	5 / 12.5	5 / 12.5
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	7.0 with backing
Rear.....mm	0.5 above rivets	0.5 above rivets	0.5 above rivets	0.5 above rivets
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175/70x14: 195/60x14:195/60x15	175/70x14: 195/60x14:195/60x15	175/70x14: 195/60x14:195/60x15	175/70x14: 195/60x14:195/60x15
Pressure - front / rear - Saloon / Hatch...bar	1.9 / 1.7	1.9 / 1.7	1.9 / 1.7	1.9 / 1.7
- Estate / Vanbar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.5 to -2.8	0.5 to -2.8	0.5 to -2.8	0.5 to -2.8
Camber	-1°25' to 5' L	-1°25' to 5' L	-1°25' to 5' L	-1°25' to 5' L
Castor	1° to 3° L	1° to 3° L	1° to 3° L	1° to 3° L
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-1.0 to 4.0	-1.0 to 4.0	-1.0 to 4.0	-1.0 to 4.0
Camber	-2°10' to -1°10'	-2°10' to -1°10'	-2°10' to -1°10'	-2°10' to -1°10'



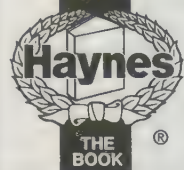
VAUXHALL/OPEL

	Cavalier/Vectra 1.7 D 1988 to 1992	Cavalier/Vectra 1.7 D 1988 to 1992	Cavalier/Vectra 1.7 D 1993 to 1995	Cavalier/Vectra 1.7 D 1993 to 1995
Torque wrench settings				
Cylinder head - stage 1.....Nm	25	25	25	25
- stage 2.....Nm	+ 60°	+ 60°	+ 90°	+ 90°
- stage 3.....Nm	+ 60°	+ 60°	+ 90°	+ 90°
- stage 4.....Nm	+ 60°	+ 60°	+ 45°	+ 45°
- stage 5.....Nm	Warm up	Warm up	Warm up	Warm up
- stage 6.....Nm	+ 45°	+ 45°	+ 45°	+ 45°
Big-end bearings.....Nm	35 + 45° N	35 + 45° N	35 + 45° N	35 + 45° N
Main bearings.....Nm	50 + 45° N	50 + 45° N	50 + 60° N	50 + 60° N
Crankshaft pulley bolt.....Nm	130 + 30° N	130 + 30° N	145 + 40° N	145 + 40° N
Camshaft pulley bolt.....Nm	75 + 60° N	75 + 60° N	75 + 65° N	75 + 65° N
Flywheel [driveplate] bolt.....Nm	60 + 30° N	60 + 30° N	60 + 30° N	60 + 30° N
Front hubs.....Nm	30, slacken, 20 + 90°	130, slacken 20 + 90°	30, slacken, 20 + 90°	30, slacken, 20 + 90°
Rear hubs.....Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	110	110	110	110
Glow plugs.....Nm	20	20	20	20
Clutch pressure plate bolts.....Nm	15	15	15	15
Injection pump sprocket.....Nm	22	22	22	22
Injectors.....Nm	70	70	70	70
Injection pump mounting bolts.....Nm	25	25	25	25
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	5.0	5.0	5.0	5.0
Gearbox.....litres	1.8	1.8	1.8	1.8
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	9.1	9.1	9.1	9.1
Fuel tank.....litres	61	61	61	61

Notes



- Not applicable, or information not available



VAUXHALL/OPEL

	Cavalier/Vectra 1.7 TD 1992 to 1995	Cavalier/Vectra 1.7 TD 1994 to 1995	Vectra-B 1.7 DTL 1995 to 1997	Vectra-B 2.0 Di 1995 to 2000
Engine				
Engine type/code.....	17DT SOHC Turbo 60kW	X17DT SOHC Turbo 60kW	X17DT SOHC Turbo 60kW	X20DTL SOHC Turbo 60kW
Capacity (cm ³) / cylinders.....	1686 / 4	1686 / 4	1686 / 4	1995 / 4
Compression ratio / pressure.....bar	22.0 /	22.0 / ≥17.0	22.0 / ≥18.5	18.5 / ≥17.0
Torque output.....Nm	168	168	168	185
Oil pressure.....idle [running] bar	1.5	1.5	2.0	1.5
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0.15	0.15	0.15	0: Hyd.
- exhaust (mm).....	0.25	0.25	0.25	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TCE
Cooling system				
Thermostat opening temperature.....°C	86	86	86 to 90	91
Radiator cap pressure.....bar	1.4 to 1.5	1.4 to 1.5	1.4 to 1.5	1.4 to 1.5
Fuel system				
Idle speed.....rpm	780 to 880	780 to 880	780 to 880	750 to 850
Maximum (no load) speed.....rpm	5300	5300	5100 to 5300	4900 to 5100
Smoke test/opacity.....M ⁻¹ %	2.0	2.0	2.0	2.0
Static timing method.....	Plunger travel	Refer to wsm	Plunger travel	Refer to wsm
Timing dimension.....mm	0.55	-	0.55 ± 0.05	Computer controlled
Crankshaft position.....mm [°]	0 TDC	-	0 TDC	-
Turbo type / ref / pressure.....bar	0.72 bar @ 4000rpm	0.72 bar @ 4000rpm	0.72 bar @ 4000rpm	-
Injection pump make.....	Bosch	-	Bosch	Bosch
Injection pump part no.....	VER3651	Zexel NP-VE 4/10 F	Zexel NP-VE4/8F2300R	EDC 15.6 / 15M Direct VP44
Injector Make / type.....	-	-	-	-
Injector part no.....	NPDNOPDN122	NPDNOPDN122	NP-DNO PDN 122	-
Injection type.....	Indirect VE4	Indirect VE4	Indirect VE4	Direct EDC 15M
Injection opening pressure, New [used]...bar	142 to 162 [142]	142 to 162 [142]	142 to 162	180 to 365
Glow plugs				
Maker.....	Bosch/Champion	Bosch/Champion	-	-
Type.....	0250 202 087 / CH158	0250 202 087 / CH68	Y711RS	-
Nominal rating.....V/A	11 / 12.5	11 / 12.5	11 / 12.5	11 /
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	7.0 with backing
Rear.....mm	0.5 above rivets	0.5 above rivets	7.0 with backing	7.0 with backing
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175/70x14: 195/60x14:195/60x15	175/70x14: 195/60x14:195/60x15	175/70x14:185/70x14:195/65x15	195/65x15: 205/60x15
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.0	2.2 / 2.0	185/70x14: 195/65x15	195/65x15: 205/60x15
- Estate / Van.....bar	2.2 / 2.1	2.2 / 2.1	2.4 / 2.4: 195/65: 2.1 / 2.1	1.9 / 1.9
			Refer to vehicle	1.9 / 1.9
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[-0°15' ± 10']	[-0°15' ± 10']	[0°10' ± 10']	[0°10' ± 10']
Camber.....	-0°40' ± 45'	-0°40' ± 45'	-1°05' ± 45'	-1°05' ± 45'
Castor.....	2° ± 1°	2° ± 1°	3°50' ± 1°	3°40' ± 1°
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°10' +30' -20']	[0°10' +30' -20']	[0°16' ± 10']	[0°30' ± 10']
Camber.....	-1°40'	-1°40'	-1°10' ± 35'	-1°55' ± 35°



VAUXHALL/OPEL

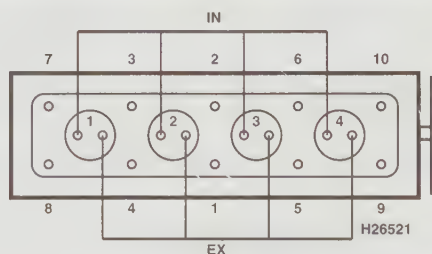
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Torque wrench settings				
Cylinder head - stage 1.....Nm	40 N	40 N	40 N	25 N
- stage 2.....Nm	+ 75°	+ 75°	+ 60° to 75°	+ 65°
- stage 3.....Nm	+ 75°	+ 75°	+ 60° to 75°	+ 65°
- stage 4.....Nm	-	-	-	+ 65°
- stage 5.....Nm	-	-	-	+ 65°
- stage 6.....Nm	-	-	-	+ 15°
Big-end bearings.....Nm	20 + 115° N	20 + 115° N	20 + 100° + 15° N	35 + 45° + 15° N
Main bearings.....Nm	88	88	88	90 + 60° + 15° N
Crankshaft pulley bolt.....Nm	196	196	196	150 + 45° + 15° N
Camshaft pulley bolt.....Nm	10	10	10	90 + 60° + 30° N
Flywheel [driveplate] bolt.....Nm	30 + 60° N	30 + 60° N	30 + 45° to 60° N	45 + 30° + 15° N
Front hubs.....Nm	130, slacken, 20 + 90°	130, slacken, 20 + 90°	130, slacken, 20 + 90°	WSM
Rear hubs.....Nm	-	-	WSM	WSM
Wheel nuts / bolts.....Nm	110	110	110	110
Glow plugs.....Nm	20	20	20	10
Clutch pressure plate bolts.....Nm	15	15	15	15
Injection pump sprocket.....Nm	69	69	69	28
Injectors.....Nm	50	50	45	45
Injection pump mounting bolts.....Nm	23	23	23	25
Injector pipe unions.....Nm	25	25	25	30
Capacities				
Engine oil & filter.....litres	4.5	4.5	5.3	5.5
Gearbox.....litres	1.9	1.9	1.9	1.9
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	7.4	7.4	6.8	7.3
Fuel tank.....litres	61	61	60	60

Notes

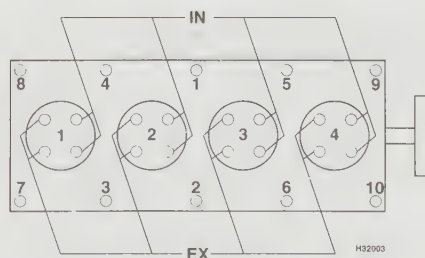
Vectra-B 2.0 Di 1995 to 2000

¹Estate: [0°26' ± 10°]

²Estate: -1°29' ± 35°



1686 cm³



1994 cm³ 16V

- Not applicable, or information not available



VAUXHALL/OPEL

	Vectra-B 2.0 TDi 1997 to 2000	Carlton/Omega-A 2.3 1987 to 1992	Carlton/Omega-A 2.3 TD 1989 to 1994	Carlton/Omega-A 2.3 TD EGR 1989 to 1994
Engine				
Engine type/code.....	X20DTH 16V Turbo 74kW	23YD SOHC 54kW	23DTR SOHC Turbo 74kW	23DTR SOHC Turbo 74kW
Capacity (cm ³) / cylinders.....	1995 / 4	2260 / 4	2260 / 4	2260 / 4
Compression ratio / pressure.....bar	18.5 / ≥17.0	23.0 / ≥17.0	23.0 / ≥17.0	23.0 / ≥17.0
Torque output.....Nm	205	0	0	0
Oil pressure.....idle [running] bar	1.5	1.8	1.8	1.8
Oil temperature.....°C	80	80	60	80
Valve clearances - inlet (mm).....	0: Hyd.	0.20	0.20	0.20
- exhaust (mm).....	0: Hyd.	0.30	0.30	0.30
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TCE	F	F	F
Cooling system				
Thermostat opening temperature.....°C	91	92	92	92
Radiator cap pressure.....bar	1.4 to 1.5	1.2 to 1.3	1.2 to 1.3	1.2 to 1.3
Fuel system				
Idle speed.....rpm	750 to 850	720 to 740 [725 to 750]	720 to 740 [725 to 750]	720 to 740 [725 to 750]
Maximum (no load) speed.....rpm	4900 to 5100	5100	5000	5000
Smoke test/opacity.....M ⁻¹ %	2.0	3.0	2.5	2.5
Static timing method.....	Refer to wsm	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	Computer controlled	0.93 ± 0.05	0.85 ± 0.05	0.85 ± 0.05
Crankshaft position.....mm [°]	-	TDC	TDC	TDC
Turbo type / ref / pressure.....bar	-	-	≥0.8 bar @ 2000rpm	-
Injection pump make.....	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	EDC 15.6 / 15M Direct VP44	VE4/9 L 243-5 [243-3]	VE4/10 L 297 [297-2]	F 2100 L 297-1 [297-3]
Injector Make / type.....	-	Bosch	Bosch	-
Injector part no.....	-	0432 217 133	0432 217 133	DN OSD 272
Injection type.....	Direct EDC 15 M	Indirect VE 4/9	Indirect VE 4/10	VE 4/10
Injection opening pressure, New [used]...bar	180 to 365	135 to 143 [117]	135 to 140 [117]	≥135 [120]
Glow plugs				
Maker.....	-	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type.....	-	0250 201 019 / CH68	0250 201 019 / CH68	0250 201 019 / CH68
Nominal rating.....V/A	11 /	11 / 12	11 / 12	12.0 / -
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	7.0 with backing
Rear.....mm	7.0 with backing	0.5 above rivets	0.5 above rivets	0.5 above rivets
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185/70x14: 195/65x15	175x14: 185/70x14: 195/65x15	175x14: 185/70x14: 195/65x15	175x14: 185/70x14: 195/65x15
Pressure - front / rear - Saloon / Hatch...bar	2.4 / 2.2	2.0 / 2.0	2.0 / 2.0	2.0 / 2.0
- Estate / Van.....bar	2.4 / 2.2	2.0 / 2.2	2.0 / 2.2	2.0 / 2.2
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°10' ± 10']	[0 to 20'] L	[0 to 20'] L	[0 to 20'] L
Camber.....	-1°05' ± 45'	-1°55' to -25' L	-1°55' to -25' L	-1°55' to -25' L
Castor.....	3°40' ± 1°	2	2	2
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°30' ± 10'] ¹	-0.5 to 5.5°	-0.5 to 5.5°	-0.5 to 5.5°
Camber.....	-1°55' ± 35' ²	-2°20' to -1° Est ⁴	-2°20' to -1° Est ⁴	-2°20' to -1° Est ⁴



VAUXHALL/OPEL

	Vectra-B 2.0 TDi 1997 to 2000	Carlton/Omega-A 2.3 1987 to 1992	Carlton/Omega-A 2.3 TD 1989 to 1994	Carlton/Omega-A 2.3 TD EGR 1989 to 1994
Torque wrench settings				
Cylinder head - stage 1.....Nm	25 N	50 N	50 N	50 N
- stage 2.....Nm	+ 65°	100	100	100
- stage 3.....Nm	+ 65°	+ 135°	+ 135°	+ 135°
- stage 4.....Nm	+ 65°	Warm up	Warm up	Warm up
- stage 5.....Nm	+ 65°	+ 30°	+ 30°	+ 30°
- stage 6.....Nm	+ 15°	+ 30°	-	-
Big-end bearings.....Nm	35 + 45° + 15° N	45 + 45° N	45 + 45° N	45 + 45° N
Main bearings.....Nm	90 + 60° + 15° N	50 + 60° M12: 115	50 + 60° M12: 70 + 608	M12: 70 + 60° ⁸
Crankshaft pulley bolt.....Nm	150 + 45° + 15° N	150	220	220
Camshaft pulley bolt.....Nm	90 + 60° + 30° N	140 to 170	140 to 170	140 to 170
Flywheel [driveplate] bolt.....Nm	45 + 30° + 15° N	60	80 + 30°	80 + 25 to 30°
Front hubs.....Nm	WSM	320	320	320
Rear hubs.....Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	110	90	90	90
Glow plugs.....Nm	10	20	20	20
Clutch pressure plate bolts.....Nm	15	15 M8: 28	15	15
Injection pump sprocket.....Nm	28	55	55	55
Injectors.....Nm	45	70	70	70
Injection pump mounting bolts.....Nm	25	-	-	-
Injector pipe unions.....Nm	30	-	-	-
Capacities				
Engine oil & filter.....litres	5.5	5.5	5.5	5.5
Gearbox.....litres	1.9	1.9	1.9	1.9
Automatic transmission.....litres	-	5.5 oil pan removed	5.5 oil pan removed	5.5 oil pan removed
Final drive.....litres	WT	0.9	1.1	1.1
Cooling system.....litres	7.3	10.9 [A/T: 10.8]	10.9 [A/T: 10.8]	10.9 [A/T: 10.8]
Fuel tank.....litres	60	75 Est: 70	75 Est: 70	75 Est: 70

Notes

Vectra-B 2.0 TDi 1997 to 2000

¹Estate: [0°26' ± 10']

²Estate: -1°29' ± 35'

Carlton/Omega-A 2.3 1987 to 1992

¹Also 195/65x15

²Sal: 2 to 4°. PAS: 4°30' to 6°30'. Est man strg: 1°30' to 3°30'. PAS: 4 to 6°

³Estate: 0 to 6.0

⁴-2°5' to -45'

⁵M10: 50 + 45 to 60°

Carlton/Omega-A 2.3 TD 1989 to 1994

¹Also 195/65x15

²Sal man strg: 2 to 4°. PAS: 4°30' to 6°30'. Est man

strg: 1°30' to 3°30'. PAS: 4 to 6°

³Estate: 0 to 6.0

⁴-2°5' to -45'

⁵M10: 50 + 45 to 60°

Carlton/Omega-A 2.3 TD EGR 1989 to 1994

¹Also 195/65x15

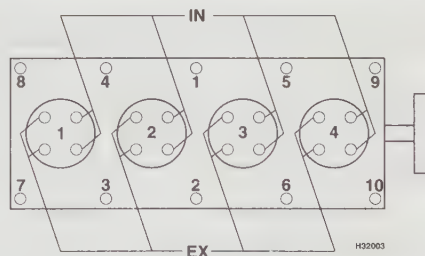
²Sal man strg: 2 to 4°. PAS: 4°30' to 6°30'. Est man

strg: 1°30' to 3°30'. PAS: 4 to 6°

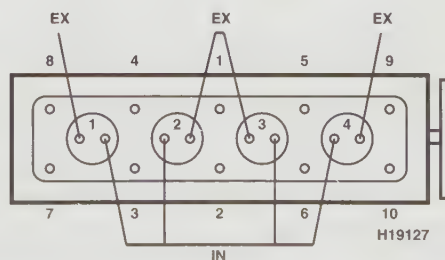
³Estate: 0 to 6.0

⁴-2°5' to -45'

⁵M10: 50 + 45 to 60°



1994 cm³ 16V



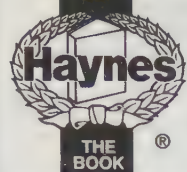
2260 cm³

- Not applicable, or information not available



VAUXHALL/OPEL

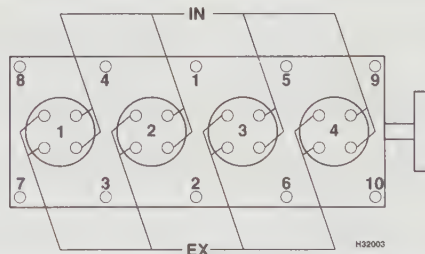
	Omega-B 2.0 TDi 16V 1998 to 2000	Omega-B 2.5 TD 1994 to 1996	Omega-B 2.5 TD 1997 to 2000	Sintra 2.2 TD 16V 1998 to 1999
Engine				
Engine type/code.....	X20DTH SOHC Turbo 16V 74kW	25 DT SOHC Turbo 96kW	X25DT SOHC Turbo 96kW	X22DTH SOHC 16V Turbo 85kW
Capacity (cm ³) / cylinders.....	1994 / 4	2498 / 6	2497 / 6	2171 / 4
Compression ration / pressurebar	18.5 / _	22.0 / ≥20.0	22.5 / ≥20.0	18.5 /
Torque outputNm	205	250	250	260
Oil pressureidle [running] bar	1.5	2.0	2.0	1.5
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-5-3-6-2-4	1-5-3-6-2-4	1-3-4-2
No. 1 cylinder position	TBE	-	TCE	TCE
Cooling system				
Thermostat opening temperature°C	92	80	80	92
Radiator cap pressurebar	1.2 to 1.5	1.4	1.4	1.2 to 1.5
Fuel system				
Idle speedrpm	700 to 1000	750 ± 50	750 ± 50	740 to 900
Maximum (no load) speedrpm	-	5300 ± 100	5300	4950 to 5050
Smoke test/opacityM ⁻¹ %	2.0	2.41	2.3	2.5
Static timing method.....	Refer to wsm	Plunger travel	Plunger travel	Refer to wsm
Timing dimension.....mm	Computer controlled	0.88 to 0.97	0.98 ± 0.02	-
Crankshaft positionmm [°]	-	0 TDC	0 TDC	-
Turbo type / ref / pressurebar	yes	-	-	-
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VP44	VE6/10 2400 R515	VP36	VP44
Injector Make / type	-	Bosch	Bosch	Multi hole
Injector part no.....	-	KCA21S76	DNOSD 300	-
Injection type.....	Direct EDC 15M	VP36	Bosch DDE 2.1	Direct EDC 15M
Injection opening pressure, New [used]...bar	180 to 365	150 to 158	150 to 158	180 to 360
Glow plugs				
Maker	_/Champion	Bosch/Champion	Beru/Champion	-
Type	CH207	0250 201 027 / CH159	719 MJ / CH159	-
Nominal ratingV/A	11 /	-	11 / 12	-
Brakes				
minimum friction material thickness				
Front.....mm	8.0 with backing	6.0 with backing	8.0 with backing	8.0 with backing
Rear.....mm	6.0 with backing	6.0 with backing	6.0 with backing	7.0 with backing
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/65x15:205/65x15:225/55x16	205/65x15	205/65x15: 225/55x16	-
Pressure - front / rear - Saloon / Hatch...bar	2.1 / 2.1	2.2 / 2.2	2.1 / 2.1	205/65x15
- Estate / Vanbar	2.1 / 2.3	2.0 / 2.2	2.1 / 2.3	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[10' ± 10'] L	[0°10' ± 10']	[10' ± 10'] L	[0° ± 2"]
Camber	-1°40' ± 45'	-1°40' ± 45'	-1°40' ± 45'	0°48' ± 30'
Castor	5°40' ± 1° Est: 5° ± 1°	5°40' ± 1°	5°40' ± 1° Est: 5° ± 1°	2°59' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°20' ± 10'] L	[0°20' ± 10']	[0°20' ± 10'] L	[0° ± 7"]
Camber	-1°50' ± 40' Est: -1°40'	-1°50' ± 40'	-1°50' ± 40' Est: -1°40'	-1° ± 15'



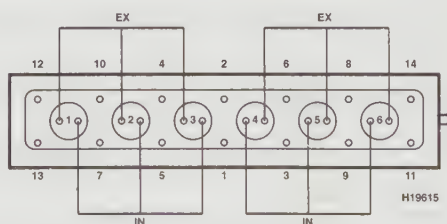
VAUXHALL/OPEL

	Omega-B 2.0 TDi 16V 1998 to 2000	Omega-B 2.5 TD 1994 to 1996	Omega-B 2.5 TD 1997 to 2000	Sintra 2.2 TD 16V 1998 to 1999
Torque wrench settings				
Cylinder head - stage 1.....Nm	25 N	80 N	80 N	25 N
- stage 2.....Nm	+ 90°	Slacken	+ 90°	+ 65°
- stage 3.....Nm	+ 90°	50	+ 90°	+ 65°
- stage 4.....Nm	+ 90°	+ 90°	+ 90°	+ 65°
- stage 5.....Nm	—	+ 90°	—	+ 65°
- stage 6.....Nm	—	warm up, + 90°	—	+ 15°
Big-end bearings.....Nm	35 + 45° + 15° N	20 + 70° N	20 + 70° N	35 + 45° + 15° N
Main bearings.....Nm	50 + 45° + 15° N	25 + 50° N	25 + 50° N	90 + 60° + 15°
Crankshaft pulley bolt.....Nm	150 + 45° + 15° N	100 + 150° N	100 + 150° N	150 + 45° + 15° N
Camshaft pulley bolt.....Nm	90 + 60° + 30° N	20 + 35° N	20 + 35° N	90 + 60° + 30° N
Flywheel [driveplate] bolt.....Nm	65 + 30° + 15° [60] N	122	112 N	45 + 30° + 15° N
Front hubs.....Nm	320	320	320	160
Rear hubs.....Nm	300	300	300	WSM
Wheel nuts / bolts.....Nm	110	110	110	140
Glow plugs.....Nm	25	23	22	10
Clutch pressure plate bolts.....Nm	15 M8: 28	15 M8: 22	15 M8: 28	18
Injection pump sprocket.....Nm	—	48	48	20
Injectors.....Nm	WSM	65	65	WSM
Injection pump mounting bolts.....Nm	25	22	22	25
Injector pipe unions.....Nm	25	25	25	15
Capacities				
Engine oil & filter.....litres	5.5	6.5	6.5	5.5
Gearbox.....litres	[1.2]	1.2	[1.2]	1.8
Automatic transmission.....litres	4.4	4.4	4.4	—
Final drive.....litres	1.0	1.0	1.0	WT
Cooling system.....litres	8.2	10.2	10.2 [AT: 10.0]	—
Fuel tank.....litres	75	75	75	70

Notes



1994 cm³ / 2171 cm³ 16V



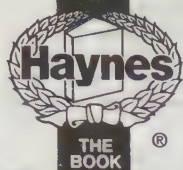
2497 cm³ / 2498 cm³

— Not applicable, or information not available



VAUXHALL/OPEL

	Frontera 2.2 Di 1998 to 2000	Frontera 2.3 TD 1991 to 1995	Frontera 2.5 TDS 1996 to 1998	Frontera 2.8 TD 1995 to 1996
Engine				
Engine type/code.....	X22DTH SOHC 16V Turbo 85kW	23DTR SOHC Turbo 63kW	VM41B OHV Turbo 85kW	4JB1TC SOHC Turbo 82kW
Capacity (cm ³) / cylinders.....	2171 / 4	2260 / 4	2499 / 4	2771 / 4
Compression ration / pressurebar	18.5 / 17.0 to 24.0	23.0 /	20.95 / 24.0	17.9 /
Torque outputNm	260	215	260	242
Oil pressureidle [running] bar	1.5	1.8	[4.0 @ 4000]	1.8
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0: Hyd.	0.20	0: Hyd.	0.40
- exhaust (mm).....	0: Hyd.	0.30	0: Hyd.	0.40
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TCE	-	-	-
Cooling system				
Thermostat opening temperature°C	92	92	82	92
Radiator cap pressurebar	1.2 to 1.5	1.2 to 1.3	1.2 to 1.5	1.5 to 1.5
Fuel system				
Idle speedrpm	740 to 900	720 to 750	775 ± 25	700 to 800
Maximum (no load) speedrpm	4950 to 5050	4900 to 5000	-	4500 to 4700
Smoke test/opacityM ⁻¹ %	2.0	2.5	2.0	2.5
Static timing method.....	Refer to wsm	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	Computer controlled	0.85 ± 0.05	0.65	0.50
Crankshaft positionmm [°]	-	0 TDC	0 TDC	[12]
Turbo type / ref / pressurebar	-	0.8 bar @ 2000	-	0.68 bar
Injection pump make.....	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VP44	VE4/10F2100L	VP 36	VE
Injector Make / type.....	Multi hole	Bosch	Bosch	-
Injector part no.....	-	DNOSD272	DNOSD272	-
Injection type.....	Direct EDC 15M	Indirect VE4	Indirect	VE
Injection opening pressure, New [used]...bar	180 to 360	135 to 143	135 to 143	181
Glow plugs				
Maker.....	-	Bosch/Champion	Bosch	-
Type.....	-	0250 200 019 / CH68	0250 201 033	-
Nominal rating.....V/A	-	-	11 / 13	-
Brakes				
minimum friction material thickness				
Front.....mm	1.0	1.0	1.0	1.0
Rear.....mm	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch.....Size	-	-	-	-
- Estate / Van.....Size	235/75x15: 245/70x16	225/75x15	235/70x16: 255/65x15	235/70x16: 255/65x15
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	2.0 / 2.0: 1.8 / 1.8	1.7 / 1.7	1.7 / 1.7	1.7 / 1.7
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 17']	2.0 ± 2.0	0.0 ± 2.0	0.0 ± 2.0
Camber.....	0° ± 1°	0°30' ± 1°	0° ± 45'	0° ± 45'
Castor.....	2°10' ± 1°	2° 30' ± 45°	2°10' ± 45'	2°10' ± 45'
King pin inclination.....	12°30' ± 30'	-	12°30' ± 30'	12°30' ± 30'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-	-	-
Camber.....	-	-	-	-



VAUXHALL/OPEL

	Frontera 2.2 TDi 1998 to 2000	Frontera 2.3 TD 1991 to 1995	Frontera 2.5 TDS 1996 to 1998	Frontera 2.8 TD 1995 to 1996
Torque wrench settings				
Cylinder head - stage 1	25 N	100 N	30, 30 ¹	25 N
- stage 2	+ 65°	+ 135°	+ 70° + 70°	+ 90°
- stage 3	+ 65°	Warm up	warm up, allow to cool	+ 90°
- stage 4	+ 65°	+ 30°	slacken	+ 90°
- stage 5	+ 65°	+ 30°	30 + 65°	-
- stage 6	+ 15°	-	+ 65° ²	-
Big-end bearings	35 + 45° + 15° N	45 + 45° N	29 + 60° N	35 + 45° + 15° N
Main bearings	90 + 60° + 15° N	70 + 60° N M10: 50 + 60° N	44	50 + 45° + 15° N
Crankshaft pulley bolt	150 + 45° + 15° N	220	196	187
Camshaft pulley bolt	90 + 60° + 30° N	150 N	-	64
Flywheel [driveplate] bolt	45 + 30° + 15° N	80 + 30°	20 + 60°	65 + 30° + 15°
Front hubs	WSM	WSM	WSM	WSM
Rear hubs	WSM	WSM	WSM	WSM
Wheel nuts / bolts	118	100 Alloy: 120	100 Alloy: 120	100 Alloy: 120
Glow plugs	10	20	15	22
Clutch pressure plate bolts	18	22	25	15
Injection pump sprocket	20	55	88	64
Injectors	WSM	70	70	37
Injection pump mounting bolts	25	-	27	19
Injector pipe unions	30	25	23	29
Capacities				
Engine oil & filter	5.5	5.7	6.25	5.5
Gearbox	2.95	2.8 Transfer: 1.4	2.8 Transfer: 1.4	2.8 Transfer: 1.4
Automatic transmission	5.5	-	-	-
Final drive	1.7 Rear: 2.4 ¹	1.7 Rear: 2.4 LSD: 1.9	1.7 Rear: 2.4 LSD: 1.9	1.7 Rear: 2.4 LSD: 1.9
Cooling system	7.9	10.9	8.8	8.8
Fuel tank	65 5dr: 75	80	80	80

Notes

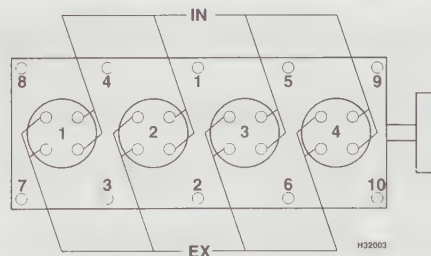
Frontera 2.2 TDi 1998 to 2000

¹Transfer: 1.45

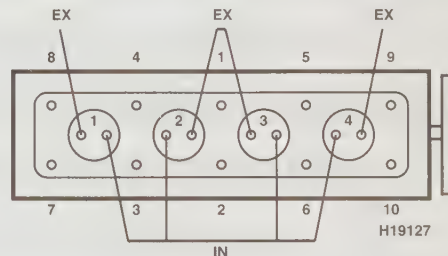
Frontera 2.5 TDS 1996 to 1998

¹M12: 30, 85, after warm up and cool down: 90 Nm

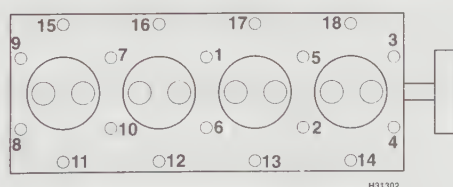
²After 20 000Km: + 15°



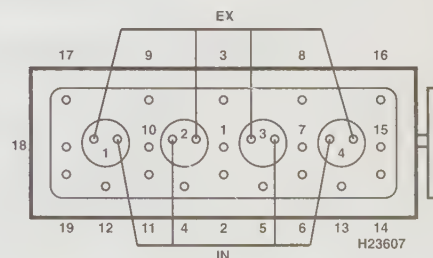
2171 cm³ 16V



2260 cm³



2499 cm³



2771 cm³

- Not applicable, or information not available

VAUXHALL/OPEL



	Monterey 3.1 TD 1994 to 1998	Brava 2.5 TDi 1994 to 2000	Midi 2.0 1988 to 1995	Midi 2.2 1988 to 1994
Engine				
Engine type/code	4GATC OHV Turbo 84kW	4JA1T OHV Turbo 56kW*	4FC1-T OHC Turbo 51kW	4FD1 OHC IDI 45kW
Capacity (cm ³) / cylinders	3069 / 4	2499 / 4	1995 / 4	2189 / 4
Compression ratio / pressure	20.1	18.4 / 30.4	21.0 / 30.4	21.5 / 30.4
Torque output	260	160	0	0
Oil pressure	-	[3.9]	[4.4]	[4.4]
Oil temperature	-	80	80	80
Valve clearances - inlet (mm)	0.40	0.40	0.25	0.25
- exhaust (mm)	0.40	0.40	0.35	0.35
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	F	F
Cooling system				
Thermostat opening temperature	82	82	80.5 to 83.5	80.5 to 83.5
Radiator cap pressure	0.9 to 1.2	0.9 to 1.2	1.0	1.0
Fuel system				
Idle speed	696 to 745	745 to 795	620	620
Maximum (no load) speed	4500 to 4700	4700 to 4900	5200	5200
Smoke test capacity	2.5	2.0	2.5	2.5
Static timing method	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension	0.50	0.50	0.50	0.50
Crankshaft position	0 TDC	[12]	[3]	[5]
Turbo type / ref / pressure	0.67 bar	-	-	-
Injection pump make	Bosch	Bosch	Diesel Kiki	Diesel Kiki
Injection pump part no.	VE	VE	-	-
Injector Make / type	Throttle type	Bosch	Bosch	Bosch
Injector part no.	-	DN12SD12T	-	-
Injection type	Indirect	Direct	Bosch VE type	Bosch VE type
Injection opening pressure, New [used]...bar	147	181	120	120 to 130
Glow plugs				
Maker	Bosch/Champion	Champion	Bosch/Champion	-
Type	0250 202 087 / CH158	CH68	0250 202 087 / CH158	-
Nominal rating	11 / 12	11 /	11 / 12	11.0 / 7.1
Brakes				
Minimum friction material thickness				
Front	1.0	1.0	1.0	1.0
Rear	1.0	1.0	1.0	1.0
Tyres - Saloon / Hatch	Size	-	-	-
- Estate / Van	Size	185x14 4x4: 205x16	185x14	185x14
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Van...bar	2.1 / 2.3*	1.8 / 4.5 4x4: 2.0 / 2.7	3.0 / 3.7*	3.0 / 3.7*
Front suspension / wheel alignment				
Toe-in - / Toe-out - /	[0° ± 17°]	[0° ± 19°] 4x4: [0° ± 17°]	1.0 to 5.0	1.0 to 5.0
Camber	0° ± 30'	0°30' ± 1°	35' ± 30'	35' ± 30'
Castor	2°10' ± 45'	1°50' ± 45' 4x4: 2°10' ± 45'	2° ± 30'	2° ± 30'
King pin inclination	12°30' ± 30'	10° ± 1°	7°25' ± 30'	7°25' ± 30'
Rear suspension / wheel alignment				
Toe-in - / Toe-out - /	-	-	-	-
Camber	-	-	-	-



VAUXHALL/OPEL

	Monterey 3.1 TD 1994 to 1998	Brava 2.5 TDi 1994 to 2000	Midi 2.0 1988 to 1995	Midi 2.2 1988 to 1994
Torque wrench settings				
Cylinder head - stage 1Nm	40 N	49 N	40	40
- stage 2Nm	+ 60°	+ 60° to 75°	130	130
- stage 3Nm	+ 60°	+ 60° to 75°	-	-
- stage 4Nm	-	-	-	-
- stage 5Nm	-	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	29 + 45° N	83 N	80 N	80 N
Main bearings.....Nm	167	167	95	95
Crankshaft pulley boltNm	WSM	WSM	120	120
Camshaft pulley boltNm	64	64	65	65
Flywheel [driveplate] bolt.....Nm	118	118	55	55
Front hubsNm	WSM	-	WSM	WSM
Rear hubsNm	WSM	-	-	-
Wheel nuts / boltsNm	118	82	108	108
Glow plugsNm	23	23	15	15
Clutch pressure plate boltsNm	20	18	18	18
Injection pump sprocket.....Nm	64	64	70	70
Injectors.....Nm	64	35	75	75
Injection pump mounting boltsNm	-	22	20	20
Injector pipe unions.....Nm	29	35	25	25
Capacities				
Engine oil & filter.....litres	6.0	4.3	5.7	5.7
Gearbox.....litres	1.95	1.5 4x4: 4.4	1.6	1.6
Automatic transmissionlitres	-	-	-	-
Final drive.....litres	1.5 Rear: 1.8 ²	1.5	1.1	1.1
Cooling system.....litres	8.6	7.0	Van: 10.0 ²	Van: 10.0 ²
Fuel tank.....litres	85	75 Double Cab: 53	60	60

Notes

Monterey 3.1 TD 1994 to 1998

¹LWB rear: 2.4

²Transfer: 1.45

Brava 2.5 TDi 1994 to 2000

¹Fitted with CAT 1997 on

Midi 2.0 1988 to 1995

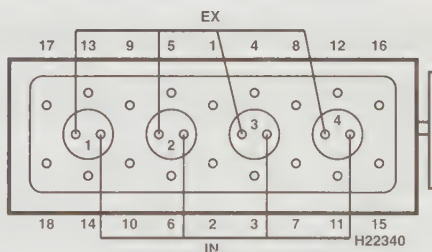
¹Bus: 3.0 / 3.1

²Bus with rear heater: 11.0

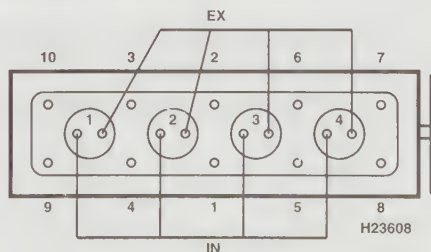
Midi 2.2 1988 to 1994

¹Bus: 3.0 / 3.1

²Bus with rear heater: 11.0

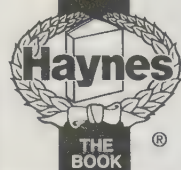


2499 cm³ / 3059 cm³



1995 cm³ / 2189 cm³

- Not applicable, or information not available



VAUXHALL/OPEL

	Midi 2.4 TD 1994 to 1997	Arena 1.9 D 1997 to 2000	Arena 2.5 D 1997 to 2000	Movano 2.5 D 1998 to 2000
Engine				
Engine type/code.....	4FG1-T SOHC Turbo 55kW	F8Q 606 SOHC 44kW	S8U 782 SOHC 55kW	S8U SOHC 58kW
Capacity (cm ³) / cylinders.....	2380 / 4	1870 / 4	2499 / 4	2499 / 4
Compression ratio / pressurebar	20.0 / 30	23.0 / _	22.0 / _	22.0 /
Torque outputNm	167	120	158	155
Oil pressureidle [running] bar	[4.5]	1.2 [5.6]	1.2 [5.6]	0.8 [3.5 @ 4000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0.25	0.40	0.40	0.50
- exhaust (mm).....	0.35	0.40	0.40	0.50
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	80	-	-	89
Radiator cap pressurebar	0.9 to 1.2	0.8 to 1.2	0.8 to 1.2	1.2
Fuel system				
Idle speedrpm	675 to 725	785 to 885	760 to 860	760 to 860
Maximum (no load) speedrpm	5000	4500 to 4700	4650 to 4750	4500 to 4700
Smoke test/opacityM ⁻¹ %	3.0	2.41	2.5	2.5
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Rotor lift
Timing dimension.....mm	0.50	1.10 ± 0.02	1.0 ± 0.02	0.97 ± 0.02
Crankshaft positionmm [°]	[5]	[0] TDC	[0] TDC	TDC
Turbo type / ref / pressurebar	-	-	-	-
Injection pump make.....	Bosch	Lucas	Bosch	Bosch
Injection pump part no.....	VE	H300575	VE4/9F 2100 R22-7	VE4/10F2100R717-1
Injector Make / type.....	Pintle	Bosch	Bosch	Bosch
Injector part no.....	-	DNOSD 193	DNOSD 193	DNOSD 301
Injection type.....	Indirect VE	Indirect	Indirect	Indirect
Injection opening pressure, New [used]...bar	147	125 ± 5	125 ± 5	115 to 128
Glow plugs				
Maker.....	-	Champion	Champion	-
Type.....	-	CH87	CH87	-
Nominal rating.....V/A	-	-	-	-
Brakes				
minimum friction material thickness				
Front.....mm	1.0	9.0 with backing	9.0 with backing	8.0 with backing
Rear.....mm	1.0	5.0 with backing	5.0 with backing	1.0
Tyres - Saloon / Hatch.....Size	-	-	-	-
- Estate / Van.....Size	185x14	165/80X14;175/80x14; 185/75x14	175/80x14; 185/75x14	195/70x15; 215/70x15;225/70x15
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	3.0 / 3.8	3.8 / 3.8	SWB: 3.8 / 3.8 LWB: 4.1 / 4.5	3.6 / 3.7; 3.5 / 3.7;3.3 / 3.7
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 ± 3.0	[-0°10' ± 10']	[-0°10' ± 10']	1.0 ± 1.0
Camber.....	0°35' ± 30'	0°30' ± 1°	0°30' ± 1°	-0°01' ± 30'
Castor.....	2° ± 30'	3° ± 1°	3° ± 1°	2°58' ± 30'
King pin inclination.....	7°25' ± 30'	9°30' ± 1°	9°30' ± 1°	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	[0°15' ± 15']	[0°15' ± 15']	3.0 ± 2.0
Camber.....	-	0°15' ± 15'	0°15' ± 15'	0°08' ± 05'

VAUXHALL/OPEL



Midi 2.4 TD
1994 to 1997

Arena 1.9 D
1997 to 2000

Arena 2.5 D
1997 to 2000

Movano 2.5 D
1998 to 2000

Torque wrench settings

Cylinder head - stage 1.....Nm	49	40	40 N	40 N
- stage 2.....Nm	132	75	40	40
- stage 3.....Nm	-	Warm up, allow to cool	+ 180°	+ 180°
- stage 4.....Nm	-	- 90°	-	-
- stage 5.....Nm	-	75	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	79 N	110 N	110 N	50 + 65° N
Main bearings.....Nm	93	80, 160	80, 160	80, 160
Crankshaft pulley bolt.....Nm	118	200	200	-
Camshaft pulley bolt.....Nm	64	25	25	-
Flywheel [driveplate] bolt.....Nm	53	120	120	120
Front hubs.....Nm	WSM	190 to 210	190 to 210	480
Rear hubs.....Nm	-	WSM	WSM	280
Wheel nuts / bolts.....Nm	108	120	120	155
Glow plugs.....Nm	23	15	15	-
Clutch pressure plate bolts.....Nm	74	25	25	-
Injection pump sprocket.....Nm	68	50	50	-
Injectors.....Nm	74	50	50	50
Injection pump mounting bolts.....Nm	-	50	50	-
Injector pipe unions.....Nm	29	25	25	-

Capacities

Engine oil & filter.....litres	5.7	5.0	6.5	6.5
Gearbox.....litres	1.55	2.5 NE3: 1.8 ¹	2.5 NE3: 1.8 ¹	2.8
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	1.1	0.8 ²	0.8 ²	WT
Cooling system.....litres	10.0	6.8	8.4	11.0
Fuel tank.....litres	60	60	60	70

Notes

Arena 1.9 D 1997 to 2000

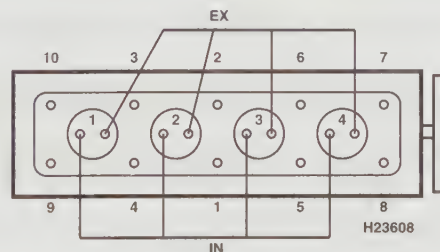
¹4x4: 2.0

²NE3: 1.45. With cooler and 4x4: 1.3

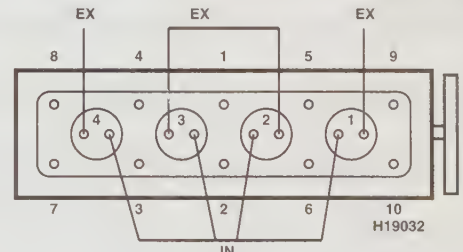
Arena 2.5 D 1997 to 2000

¹4x4: 2.0

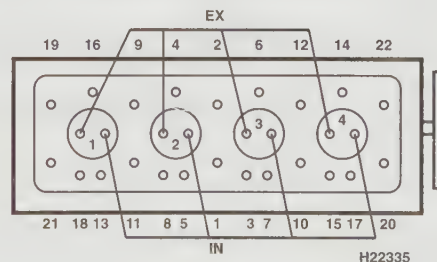
²NE3: 1.45. With cooler and 4x4: 1.3



2380 cm³



1870 cm³



2499 cm³

- Not applicable, or information not available



VAUXHALL/OPEL

	Movano 2.8 TD 1998 to 2000			
Engine				
Engine type/code	S9W 702 SOHC Turbo 84kW			
Capacity (cm ³) / cylinders	2799 / 4			
Compression ratio / pressure	19.0 /			
Torque output	260			
Oil pressureidle [running] bar	-			
Oil temperature°C	-			
Valve clearances - inlet (mm)	0.50			
- exhaust (mm)	0.50			
Injection order	1-3-4-2			
No. 1 cylinder position	-			
Cooling system				
Thermostat opening temperature°C	89			
Radiator cap pressurebar	1.2			
Fuel system				
Idle speedrpm	760 to 860			
Maximum (no load) speedrpm	4000 ± 100			
Smoke test/opacityM ⁻¹ %	2.5			
Static timing method.....	Rotor lift			
Timing dimension.....mm	1.11 ± 0.02			
Crankshaft positionmm [°]	TDC			
Turbo type / ref / pressure	Garrett GT17			
Injection pump make	Bosch			
Injection pump part no.....	VE4/12F1800R721			
Injector Make / type	Bosch			
Injector part no.....	DLSA 134 P604			
Injection type.....	Direct			
Injection opening pressure, New [used]...bar	235 to 243			
Glow plugs				
Maker	-			
Type	-			
Nominal rating.....V/A	-			
Brakes				
minimum friction material thickness				
Front.....mm	8.0 with backing			
Rear.....mm	1.0			
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/70x15: 215/70x15:225/70x15			
Pressure - front / rear - Saloon / Hatch...bar	-			
- Estate / Vanbar	3.6 / 3.7: 3.5 / 3.7:3.3 / 3.7			
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 ± 1.0			
Camber	-0°01' ± 30'			
Castor	2°58' ± 30'			
King pin inclination.....	-			
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	3.0 ± 2.0			
Camber	0°08' ± 05'			

VAUXHALL/OPEL



Movano 2.8 TD
1998 to 2000

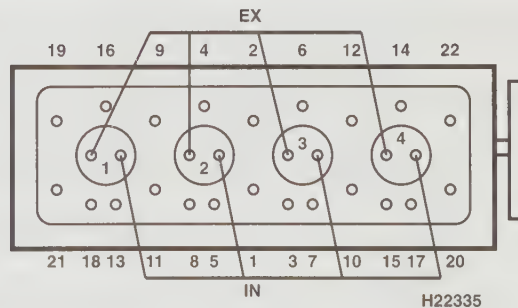
Torque wrench settings

Cylinder head - stage 1	Nm	-
- stage 2	Nm	-
- stage 3	Nm	-
- stage 4	Nm	-
- stage 5	Nm	-
- stage 6	Nm	-
Big-end bearings	Nm	50 + 65° N
Main bearings	Nm	80, 160
Crankshaft pulley bolt	Nm	200
Camshaft pulley bolt	Nm	25
Flywheel [driveplate] bolt	Nm	120
Front hubs	Nm	480
Rear hubs	Nm	280
Wheel nuts / bolts	Nm	155
Glow plugs	Nm	15
Clutch pressure plate bolts	Nm	25
Injection pump sprocket	Nm	-
Injectors	Nm	50
Injection pump mounting bolts	Nm	-
Injector pipe unions	Nm	-

Capacities

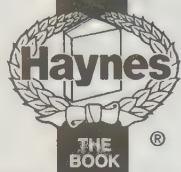
Engine oil & filter	litres	6.5
Gearbox	litres	2.8
Automatic transmission	litres	-
Final drive	litres	WT
Cooling system	litres	11.0
Fuel tank	litres	70

Notes



2799 cm³

- Not applicable, or information not available



VOLKSWAGEN

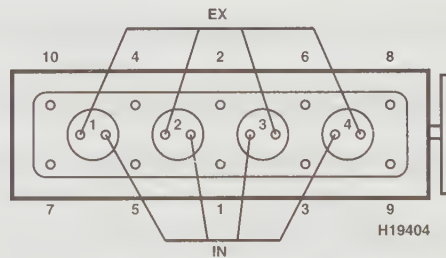
	Lupo 1.7 SDi 1998 to 2000	Polo 1.4 1990 to 1994	Polo Classic / Caddy 1.7 Di 1996 to 1998	Polo 1.7 SDi 1997 to 2000
Engine				
Engine type/code.....	AKU SOHC 8V EGR 44kW	1W SOHC 35kW	AHG SOHC 8V 42kW	AKU SOHC 8V 44kW
Capacity (cm ³) / cylinders.....	1699 / 4	1398 / 4	1715 / 4	1715 / 4
Compression ratio / pressure.....bar	19.5 /	22.5 / ≥25.0	19.5 / _	19.5 / ≥19.0
Torque output.....Nm	115	0	112	115
Oil pressure.....idle [running] bar	[2.0 @ 2000]	[2.0]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature.....°C	85	87	84	85
Radiator cap pressure.....bar	1.4 to 1.6	1.2 to 1.5	1.3 to 1.5	1.4 to 1.6
Fuel system				
Idle speed.....rpm	-	900 ± 50	861 to 945 N/A	800 ± 50
Maximum (no load) speed.....rpm	-	5600 ± 100	-	-
Smoke test/opacity.....M ⁻¹ %	2.0	2.0	2.0	2.0
Static timing method.....	Refer to wsm	Plunger travel	Refer to wsm	Refer to wsm
Timing dimension.....mm	Computer controlled	0.95 ± 0.02	-	Computer controlled
Crankshaft position.....mm [°]	-	TDC	-	-
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	-	Bosch	Bosch	-
Injection pump part no.....	-	031 130 107B	VE4/10 R640	-
Injector Make / type.....	-	Bosch	Bosch	-
Injector part no.....	-	068 130 211G	0432 193 810/1	-
Injection type.....	Direct	-	Direct SDI	SDI
Injection opening pressure, New [used]...bar	190 to 200	≥130 [120]	190 to 200 [170]	-
Glow plugs				
Maker.....	Champion	Bosch	Bosch	-
Type.....	CH171	0250 201 032	0250 202 022	-
Nominal rating.....V/A	11 /	-	11.5 / 12	-
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	7.0 with backing
Rear.....mm	2.5	2.5	2.5	2.5
Tyres - Saloon / Hatch.....Size	175/65x13: 185/55x14	145x13: 155/70x13: 165/65x13	175/65x13:185/55x14:195/45x15	175/65x13:185/55x14:195/45x15
- Estate / Van.....Size	-	-	-	-
Pressure - front / rear - Saloon / Hatch...bar	2.0 / 1.9: 2.2 / 2.0	1.7 / 1.7	-	2.1 / 2.1
- Estate / Van.....bar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 10°]	[0° ± 10°]	[0° ± 10°]	[0° ± 10°]
Camber.....	-45' ± 20'	0° ± 30'	-0°25' ± 20'	-0°25' ± 20'
Castor.....	1°20' ± 30'	2°20' ± 30'	1°20' ± 30'	1°20' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°20' ± 10°]	[20° ± 10°]	[0°20' ± 10°]	[0°20' ± 10°]
Camber.....	-1°25' ± 20'	-1°30' ± 10°	-1°30' ± 10°	-1°30' ± 10°



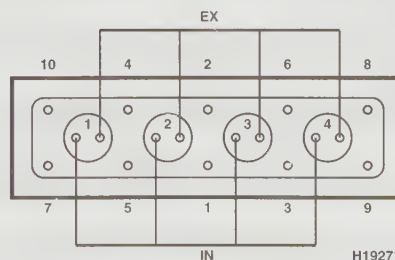
VOLKSWAGEN

	Lupo 1.7 SDi 1998 to 2000	Polo 1.4 1990 to 1994	Polo Classic / Caddy 1.7 Di 1996 to 1998	Polo 1.7 SDi 1997 to 2000
Torque wrench settings				
Cylinder head - stage 1.....Nm	40 N	40	40 N	40 N
- stage 2.....Nm	60	60	60	60
- stage 3.....Nm	+ 90°	+ 180°	+ 90°	+ 90°
- stage 4.....Nm	+ 90°	Warm up	+ 90°	+ 90°
- stage 5.....Nm	-	+ 90°	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	30 + 90° N	30 + 90° N	30 + 90° N	30 + 90° N
Main bearings.....Nm	65 + 90° N	65	65 + 90° N	65 + 90° N
Crankshaft pulley bolt.....Nm	90 + 90° N	90 + 180°	90 + 90° oiled N	90 + 90° oiled N
Camshaft pulley bolt.....Nm	45	45	45	45
Flywheel [driveplate] bolt.....Nm	60 + 90° N	30 + 90°	60 + 90° N	60 + 90° N
Front hubs.....Nm	200 - 360°, 50 + 30°	210	WSM	WSM
Rear hubs.....Nm	175 N	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	110	90	110	110
Glow plugs.....Nm	15	30	25	15
Clutch pressure plate bolts.....Nm	-	25	10	10
Injection pump sprocket.....Nm	55	50	55	55
Injectors.....Nm	-	70	20	20
Injection pump mounting bolts.....Nm	-	25	25	25
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	4.7	3.5	3.4	5.0
Gearbox.....litres	2.7	3.1	3.1	2.7
Automatic transmission.....litres	-	-	5.7 filled for life	-
Final drive.....litres	-	WT	WT	WT
Cooling system.....litres	6.5	5.5	5.5	6.5
Fuel tank.....litres	-	42	45	45

Notes



1699 cm³ / 1715 cm³



1398 cm³

- Not applicable, or information not available



VOLKSWAGEN

	Polo Classic / Caddy 1.7 Di 1997 to 2000	Polo 1.9 SD 1995 to 1997	Polo 1.9 SDi 1996 to 1998	Polo Classic / Caddy 1.9 D 1995 to 2000
Engine				
Engine type/code.....	AKW SOHC 8V EGR 44kW	AEF SOHC 8V 47kW	AGD SOHC 8V 47kW	AEY SOHC 8V 47kW
Capacity (cm ³) / cylinders.....	1715 / 4	1896 / 4	1896 / 4	1896 / 4
Compression ratio / pressure.....bar	19.5 / _	22.5 / 25 to 31	19.5 / 25 to 31	19.5 / _
Torque output.....Nm	112	124	124	125
Oil pressure.....idle [running] bar	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature.....°C	84	84	85	84
Radiator cap pressure.....bar	1.3 to 1.5	1.3 to 1.5	1.4 to 1.6	1.3 to 1.5
Fuel system				
Idle speed.....rpm	861 to 945	940 ± 20	875 to 950	875 to 950
Maximum (no load) speed.....rpm	-	4950 to 5150	4950 to 5150	4950 to 5150
Smoke test/opacity.....M ⁻¹ %	2.0	2.0	2.0	2.0
Static timing method.....	Refer to wsm	Refer to wsm	Refer to wsm	Refer to wsm
Timing dimension.....mm	Computer controlled	-	Computer controlled	-
Crankshaft position.....mm [°]	-	-	-	-
Turbo type / ref / pressure.....bar	-	-	-	-
Injection pump make.....	-	Lucas	Bosch	Bosch
Injection pump part no.....	-	DPC	VE4/10 R640	VE
Injector Make / type.....	-	CAV	Bosch	Bosch
Injector part no.....	-	-	0432 193 810/1	-
Injection type.....	Direct	Indirect DPC	Direct SDI	Direct VE
Injection opening pressure, New [used]...bar	190 to 200	130 to 138	190 to 200 [170]	190 to 200 [170]
Glow plugs				
Maker.....	-	Bosch	Bosch	Bosch
Type.....	-	0250 202 022	0250 202 022	0250 202 022
Nominal rating.....V/A	-	11.5 / 12	11.5 / 12	11.5 / 12
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	7.0 with backing
Rear.....mm	2.5	2.5	2.5	2.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175/65x13:185/55x14:195/45x15	175/65x13	175/65x13:185/55x14:195/45x15	185/60x14
Pressure - front / rear - Saloon / Hatch...bar	-	2.1 / 2.1	2.1 / 2.1	2.1 / 2.0
- Estate / Van.....bar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 10°]	[0° ± 10°]	[0° ± 10°]	[0° ± 10°]
Camber.....	-0°25' ± 20'	-0°25' ± 20'	-0°25' ± 20'	-0°25' ± 20'
Castor.....	1°20' ± 30'	1°20' ± 30'	1°20' ± 30'	1°20' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°20' ± 10°]	[0°20' ± 10°]	[0°20' ± 10°]	[0°20' ± 10°]
Camber.....	-1°30' ± 10'	-1°30' ± 10'	-1°30' ± 10'	-1°30' ± 10'



VOLKSWAGEN

Polo Classic / Caddy 1.7 Di
1997 to 2000

Polo 1.9 SD
1995 to 1997

Polo 1.9 SDi
1996 to 1998

Polo Classic / Caddy 1.9 D
1995 to 2000

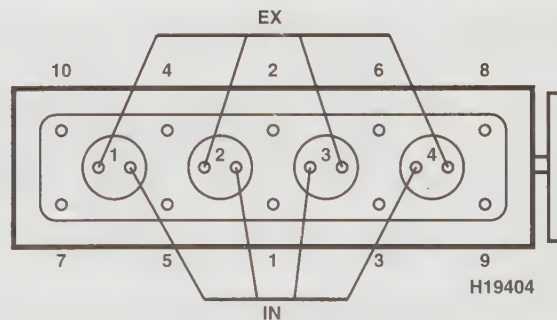
Torque wrench settings

Cylinder head - stage 1	Nm	40 N	40 N	40 N	40 N
- stage 2	Nm	60	60	60	60
- stage 3	Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4	Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5	Nm	-	-	-	-
- stage 6	Nm	-	-	-	-
Big-end bearings	Nm	30 + 90° N	30 + 90° N	30 + 90° N	30 + 90° N
Main bearings	Nm	65 + 90° N	65 + 90° N	65 + 90° N	65 + 90° N
Crankshaft pulley bolt	Nm	90 + 90° oiled N	90 + 120° oiled N	90 + 90° oiled N	90 + 90° oiled N
Camshaft pulley bolt	Nm	45	80	45	45
Flywheel [driveplate] bolt	Nm	60 + 90° N	60 + 90° N	60 + 90° N	60 + 90° N
Front hubs	Nm	WSM	WSM	WSM	WSM
Rear hubs	Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts	Nm	110	110	110	110
Glow plugs	Nm	25	25	15	15
Clutch pressure plate bolts	Nm	10	20	10	20
Injection pump sprocket	Nm	55	25	55	55
Injectors	Nm	20	70	20	20
Injection pump mounting bolts	Nm	25	-	25	25
Injector pipe unions	Nm	25	-	25	25

Capacities

Engine oil & filter	litres	3.4	4.7	5.0	4.3
Gearbox	litres	3.1	3.1	2.7	3.1
Automatic transmission	litres	5.7 filled for life	5.7 filled for life	-	5.7 filled for life
Final drive	litres	WT	WT	WT	WT
Cooling system	litres	5.5	5.5	6.5	5.5
Fuel tank	litres	45	45	45	45

Notes

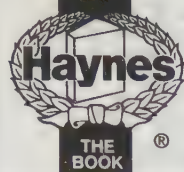


1715 cm³ / 1896 cm³



VOLKSWAGEN

	Polo Classic / Caddy 1.9 D 1995 to 2000	Polo Classic / Caddy 1.9 TDi 1997 to 2000	Polo Classic / Caddy 1.9 TDi 1997 to 2000	Polo Classic / Caddy 1.9 TDi 1998 to 1999
Engine				
Engine type/code	1Y SOHC 8V 47kW	AHU SOHC Turbo 66kW	ALE SOHC 8V EGR Turbo 66kW	AFN SOHC 8V Turbo 81kW ¹
Capacity (cm ³) / cylinders	1896 / 4	1896 / 4	1896 / 4	1896 / 4
Compression ratio / pressure	22.5 / 26 to 34	19.5 / 25 to 31	19.5 / 25 to 31	19.5 / 25 to 31
Torque output	125 Nm	202	210	235
Oil pressure Idle [running] bar	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature °C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature °C	84	84	84	84
Radiator cap pressure	1.3 to 1.5 bar	1.3 to 1.5	1.3 to 1.5	1.3 to 1.5
Fuel system				
Idle speed rpm	870 to 930	861 to 945 N/A	861 to 945	875 to 950
Maximum (no load) speed rpm	4950 to 5150	4800 to 5200	—	5200
Smoke test/opacity M ⁻¹ %	2.0	2.0	2.0	2.0
Static timing method	Plunger travel	Plunger travel	Refer to wsm	Refer to wsm
Timing dimension	0.9 ± 0.02	0.7 ± 0.02	Computer controlled	—
Crankshaft position mm [°]	TDC	TDC	—	—
Turbo type / ref / pressure	—	1.8 to 2.0 bar @ 3000 rpm	—	0.5 to 0.65 bar @ 4000 rpm
Injection pump make	Bosch	Bosch	—	Bosch
Injection pump part no.	VE4/9 R430	VE4/10 R440/1	—	VER 510 0460 404 986
Injector Make / type	Bosch	Bosch	—	Bosch
Injector part no.	0432 217 240	—	—	0432 193 838
Injection type	Indirect VE	Direct VE	Direct	Direct VER
Injection opening pressure, New [used]...bar	130 to 138	190 to 200 [170]	190 to 200	190 to 200 [170]
Glow plugs				
Maker	Bosch/Champion	Bosch	Champion	Bosch
Type	0250 201 032 / CH160	0250 202 009	CH171	0250 202 009
Nominal rating V/A	—	11.5 / 12	11 /	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	7.0 with backing
Rear.....mm	2.5	2.5	2.5	2.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175/65x13:185/55x14:195/45x15	185/60x14	175/65x13:185/55x14:195/45x15	185/60x14
Pressure - front / rear - Saloon / Hatch...bar	—	2.1 / 2.0	—	2.4 / 2.2
- Estate / Vanbar	2.2 / 2.4	—	—	2.3 / 2.2
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 10°]	[0° ± 10°]	[0° ± 10°]	[0° ± 10°]
Camber	-0°25' ± 20'	-0°25' ± 20'	-0°25' ± 20'	-0°25' ± 20'
Castor	1°20' ± 30'	1°20' ± 30'	1°20' ± 30'	1°20' ± 30'
King pin inclination.....	—	—	—	—
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°20' ± 10°]	[0°20' ± 10°]	[0°20' ± 10°]	[0°20' ± 10°]
Camber	-1°30' ± 10'	-1°30' ± 10'	-1°30' ± 10'	-1°30' ± 10'



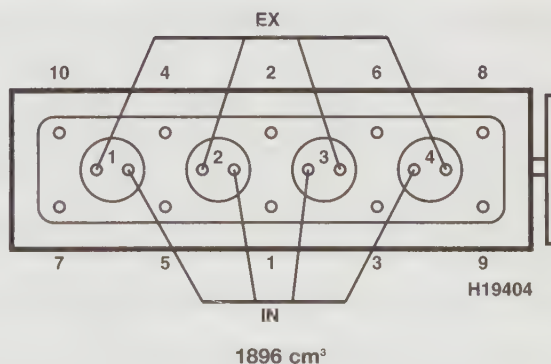
VOLKSWAGEN

	Polo Classic / Caddy 1.9 D 1995 to 2000	Polo Classic / Caddy 1.9 TDi 1997 to 2000	Polo Classic / Caddy 1.9 TDi 1997 to 2000	Polo Classic / Caddy 1.9 TDi 1998 to 1999
Torque wrench settings				
Cylinder head - stage 1.....Nm	40 N	40 N	40 N	40 N
- stage 2.....Nm	60	60	60	60
- stage 3.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	30 + 90° N	30 + 90° N	30 + 90° N	30 + 90° N
Main bearings.....Nm	65 + 90° N	65 + 90° N	65 + 90° N	65 + 90° N
Crankshaft pulley bolt.....Nm	90 + 90° oiled N	90 + 90° oiled N	90 + 90° oiled N	90 + 90° oiled N
Camshaft pulley bolt.....Nm	45	45	45	45
Flywheel [driveplate] bolt.....Nm	60 + 90° N	60 + 90° N	60 + 90° N	60 + 90° N
Front hubs.....Nm	WSM	265	265	265
Rear hubs.....Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	110	110	110	110
Glow plugs.....Nm	25	25	25	25
Clutch pressure plate bolts.....Nm	10	20	10	10
Injection pump sprocket.....Nm	25	55	55	55
Injectors.....Nm	70	20	20	20
Injection pump mounting bolts.....Nm	25	25	25	25
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	3.4	4.3	4.3	3.4
Gearbox.....litres	3.1	3.1	3.1	3.1
Automatic transmission.....litres	5.7 filled for life	5.7 filled for life	5.7 filled for life	5.7 filled for life
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	5.5	5.5	5.5	5.5
Fuel tank.....litres	45	45	45	45

Notes

Polo Classic / Caddy 1.9 TDi 1998 to 1999

¹With intercooler



– Not applicable, or information not available



VOLKSWAGEN

	Beetle 1.9 TDi 1999 to 2000	Golf / Jetta 1.6 D 1983 to 1992	Golf / Jetta 1.6 D 1983 to 1992	Golf / Jetta 1.6 TD 1989 to 1992
Engine				
Engine type/code.....	ALH SOHC 66kW	JP/A* SOHC 40kW	JP/A* SOHC 40kW	RA/SB SOHC Turbo 59kW
Capacity (cm ³) / cylinders.....	1896 / 4	1588 / 4	1588 / 4	1588 / 4
Compression ration / pressurebar	19.5 /	23.0 / ≥26.0	23.0 / ≥26.0	23.0 / ≥26.0
Torque outputNm	210	0	0	0
Oil pressureidle [running] bar	[2.0 @ 2000]	[2.0]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0.15 to 0.25'	0.15 to 0.25'	0: Hyd.
- exhaust (mm)	0: Hyd.	0.35 to 0.45'	0.35 to 0.45'	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	85	87	87	87
Radiator cap pressurebar	1.4 to 1.6	1.2 to 1.5	1.2 to 1.5	1.2 to 1.5
Fuel system				
Idle speedrpm	860 to 940	850 ± 100	850 ± 100	850 ± 100
Maximum (no load) speedrpm	5200	5350 ± 50	5350 ± 50	5100 ± 100
Smoke test/opacityM ⁻¹ %	2.0	2.0	2.0	2.0
Static timing method.....	Refer to wsm	Plunger travel	Rotor groove	Plunger travel
Timing dimension.....mm	-	0.9 ± 0.02	Dimension on pump	SB: 0.9 ± 0.02'
Crankshaft positionmm [°]	-	[0] TDC	[0±2]	[0] TDC
Turbo type / ref / pressurebar	1.7 to 2.2 bar @ 3000 rpm	-	-	0.64 to 0.72 bar
Injection pump make	Bosch	Bosch	CAV	Bosch
Injection pump part no.....	-	VE 4/9 0460 494 147	-	VE4/9 0460 494 239
Injector Make / type	-	Bosch	CAV	Bosch
Injector part no.....	-	0432 217 083	-	0432 217 185
Injection type.....	EDC	Indirect VE	Indirect DPC	Indirect VE
Injection opening pressure, New [used]...bar	220 to 230 [200]	130 to 138 [120]	130 to 138 [120]	155 [140]
Glow plugs				
Maker	-	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type	-	0250 201 032 / CH69	0250 201 032 / CH69	0250 201 032 / CH69
Nominal ratingV/A	-	11 / 12	11 / 12	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	7.0 with backing
Rear.....mm	7.5 with backing	2.5	2.5	2.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/65x15: 205/55x16	155x13: 175/70x13	155x13: 175/70x13	175/70x13: 185/60x14
Pressure - front / rear - Saloon / Hatch...bar	2.2 / 2.4	2.0 / 1.8	2.0 / 1.8	2.0 / 1.8
- Estate / Vanbar	-	-	-	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 10']	[0° ± 10']	[0° ± 10']	[0° ± 10']
Camber	-33' ± 30'	-30' ± 20'	-30' ± 20'	-30' ± 20'
Castor	7°50' ± 30'	1°30' ± 30'	1°30' ± 30'	1°30' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[25' ± 10']	[25' ± 15'] ²	[25' ± 15'] ²	[25' ± 15'] ²
Camber	-1°27' ± 10'	-1°40' ± 20' ³	-1°40' ± 20' ³	-1°40' ± 20' ³



VOLKSWAGEN

	Beetle 1.9 TDi 1999 to 2000	Golf / Jetta 1.6 D 1983 to 1992	Golf / Jetta 1.6 D 1983 to 1992	Golf / Jetta 1.6 TD 1989 to 1992
Torque wrench settings				
Cylinder head - stage 1.....Nm	40 N	40	40	40
- stage 2.....Nm	60	60	60	60
- stage 3.....Nm	+ 90°	+ 180°	+ 180°	+ 180°
- stage 4.....Nm	+ 90°	Warm engine, + 90°	Warm engine, + 90°	Warm engine, + 90°
- stage 5.....Nm	—	After 1000km,	After 1000km,	After 1000km,
- stage 6.....Nm	—	+ 90°	+ 90°	+ 90°
Big-end bearings.....Nm	30 + 90° N	Thread length 15mm: 45 ⁴	Thread length 15mm: 45 ⁴	30 + 180° N
Main bearings.....Nm	65 + 90 N	65	65	65
Crankshaft pulley bolt.....Nm	120 + 90° N	Hexagon: 180° ⁵	Hexagon: 180° ⁵	Hexagon: 180° ⁴
Camshaft pulley bolt.....Nm	45	45	45	45
Flywheel [driveplate] bolt.....Nm	60 + 90° N	30 + 90°	30 + 90°	30 + 90°
Front hubs.....Nm	50 + 30° N	230	230	230
Rear hubs.....Nm	175 N	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	120	110	110	110
Glow plugs.....Nm	15	30	30	30
Clutch pressure plate bolts.....Nm	—	20	20	20
Injection pump sprocket.....Nm	20 + 90° N	45	45	45
Injectors.....Nm	20	70	70	70
Injection pump mounting bolts.....Nm	—	25	25	25
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	4.5	3.5 8.85 ▶: 4.5	3.5 8.85 ▶: 4.5	4.5
Gearbox.....litres	1.9	1.5 [2.0]	1.5 [2.0]	2.0
Automatic transmission.....litres	—	3.0	3.0	—
Final drive.....litres	WT	AT: 0.75	AT: 0.75	WT
Cooling system.....litres	6.0	6.5	6.5	6.5
Fuel tank.....litres	—	55	55	55

Notes

Golf / Jetta 1.6 D 1983 to 1992

¹8.85 ▶: 0: Hydraulic adjusters

²2.90 ▶: [+20°±10°]

²2.90 ▶: [-1°30'±10°]

⁵JPA: 37kW

⁴Thread length 25mm: 30 + 90°

⁵12 point splined bolts: 90 + 180°

Golf / Jetta 1.6 D 1983 to 1992

¹8.85 ▶: 0: Hydraulic adjusters

²2.90 ▶: [20°±10°]

²2.90 ▶: [-1°30'±10°]

⁵JPA: 37kW

⁴Thread length 25mm: 30 + 90°

⁵12 point splined bolts: 90 + 180°

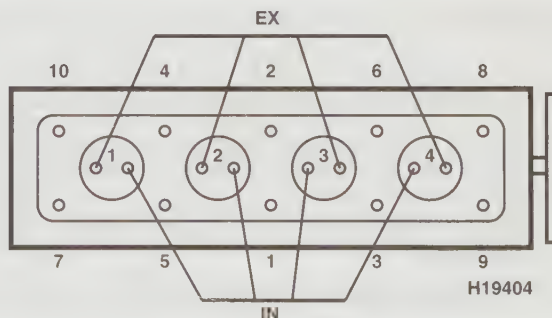
Golf / Jetta 1.6 TD 1989 to 1992

¹RA: 1.00±0.02

²2.90 ▶: [20°±10°]

²2.90 ▶: [-1°30'±10°]

⁴12 point splined bolts: 90 + 180°



1588 cm³ / 1896 cm³



VOLKSWAGEN

	Golf / Jetta 1.6 D CAT 1989 to 1992	Golf / Vento 1.9 TD 1991 to 1994	Golf / Vento 1.9 D 1991 to 1994	Golf / Vento 1.9 D 1995 to 1999
Engine				
Engine type/code.....	1V SOHC Turbo 44kW	AAZ SOHC Turbo 55kW	1Y SOHC 47kW	AEY SOHC 47kW
Capacity (cm ³) / cylinders.....	1588 / 4	1896 / 4	1896 / 4	1896 / 4
Compression ration / pressurebar	23.0 / ≥26.0	22.5 / 26 to 34	22.5 / 26 to 34	19.5 / 26 to 34
Torque outputNm	0	150	124	124
Oil pressureidle [running] bar	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	87	85	85	85
Radiator cap pressurebar	1.2 to 1.5	1.4 to 1.6	1.4 to 1.6	1.4 to 1.6
Fuel system				
Idle speedrpm	850 ± 30	900 ± 30	900 ± 30	900 ± 30
Maximum (no load) speedrpm	5350 ± 100	5200 ± 50	5200 ± 50	5200
Smoke test/opacityM ⁻¹ %	2.0	2.0	2.0	2.5
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Plunger travel
Timing dimension.....mm	1.0 ± 0.02	0.8 ± 0.02	0.9 ± 0.02	0.9 ± 0.02
Crankshaft positionmm [°]	[0] TDC	0 TDC	0 TDC	0 TDC
Turbo type / ref / pressurebar	0.64 to 0.72 bar	0.6 to 0.83 bar	-	-
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VE4/8 0460 484 027	VE4/9 R433 0460 484 286	VE4/9 R430 0460 484 046	VE 0460 404 989
Injector Make / type.....	Bosch	Bosch	Bosch	-
Injector part no.....	0432 217 240	0432 217 244	0432 217 240	-
Injection type.....	Indirect VE	Indirect VE	Indirect VE	Direct VE
Injection opening pressure, New [used]...bar	155 [140]	150 to 158 [140]	130 to 138 [120]	190 to 200 [170]
Glow plugs				
Maker	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch
Type	0250 201 032 / CH69	0250 201 032 / CH160	0250 201 032 / CH160	0250 201 032
Nominal rating.....V/A	11 / 12	11.5 / 8	-	11.5 / 12
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	7.0 with backing
Rear.....mm	2.5	2.5	2.5	2.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175/70x13: 185/60x14	175/70x13: 185/60x14	175/70x13: 185/60x14	175/70x13: 185/60x14
Pressure - front / rear - Saloon / Hatch...bar	-	185/60x14	185/60x14	185/60x14
- Estate / Vanbar	2.0 / 1.8	2.1 / 1.9: 2.0 / 1.8	2.1 / 1.9: 2.0 / 1.8	2.1 / 1.9: 2.0 / 1.8
	-	2.0 / 2.0	2.0 / 2.0	2.0 / 2.0
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 10°]	[0° ± 10°]	[0° ± 10°]	[0° ± 10°]
Camber	-30' ± 20'	-0°30' ± 20'	-0°30' ± 20'	-0°30' ± 20'
Castor	1°30' ± 30'	1°45' ± 30'	1°45' ± 30'	1°45' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[25' ± 15']	[-20' ± 10°]	[-20' ± 10°]	[-0°20' ± 10°]
Camber	-1°40' ± 20°	-1°30' ± 10'	-1°30' ± 10'	-1°30' ± 10'



VOLKSWAGEN

	Golf / Jetta 1.6 D CAT 1989 to 1992	Golf / Vento 1.9 TD 1991 to 1994	Golf / Vento 1.9 D 1991 to 1994	Golf / Vento 1.9 D 1995 to 1999
Torque wrench settings				
Cylinder head - stage 1.....Nm	40 N	40 N	40 N	40 N
- stage 2.....Nm	60	60	60	60
- stage 3.....Nm	+ 180°	+ 90°	+ 90°	+ 90°
- stage 4.....Nm	Warm engine, + 90°	+ 90°	+ 90°	+ 90°
- stage 5.....Nm	After 1000km,	—	—	—
- stage 6.....Nm	+ 90°	—	—	—
Big-end bearings.....Nm	30 + 180° N	30 + 90° N	30 + 90° N	30 + 90° N
Main bearings.....Nm	65	65 + 90° N	65 + 90° N	65 + 90° N
Crankshaft pulley bolt.....Nm	Hexagon: 180°	90 + 90° N	90 + 90° N	90 + 90°
Camshaft pulley bolt.....Nm	45	45	45	45
Flywheel [driveplate] bolt.....Nm	30 + 90°	60 + 90° N	30 + 90° N	60 + 90° N
Front hubs.....Nm	230	265	265	265
Rear hubs.....Nm	WSM	WSM	WSM	—
Wheel nuts / bolts.....Nm	110	110	110	110
Glow plugs.....Nm	30	25	25	15
Clutch pressure plate bolts.....Nm	20	25	25	25
Injection pump sprocket.....Nm	45	45	45	55
Injectors.....Nm	70	70	70	20
Injection pump mounting bolts.....Nm	25	25	25	25
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	4.5	4.5	4.5	4.5
Gearbox.....litres	2.0	2.0	2.0	2.0
Automatic transmission.....litres	—	—	—	—
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	6.5	6.5	6.5	6.5
Fuel tank.....litres	55	55 Est: 60	55 Est: 60	55 Est: 60

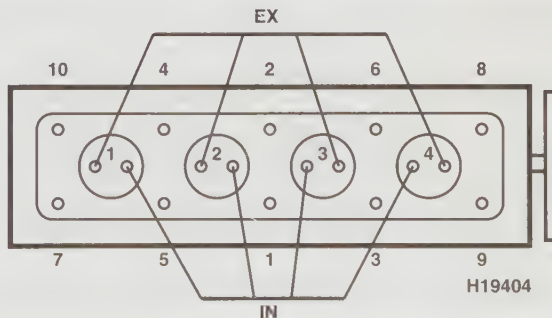
Notes

Golf / Jetta 1.6 D CAT 1989 to 1992

*2.90 ►: [20'±10']

*2.90 ►: -1°30'±10'

*12 point splined bolts: 90 + 180°



1588 cm³ / 1896 cm³



VOLKSWAGEN

	Golf / Vento 1.9 TD 1995 to 1997	Golf / Vento 1.9 TD 1994 to 1998	Golf / Vento 1.9 TDi 1996 to 1998	Golf / Bora 1.9 SDi 1998 to 2000
Engine				
Engine type/code.....	AAZ SOHC 8V Turbo 55kW	1Z / AHU SOHC 8V Turbo 66kW	AFN SOHC Turbo 8V 81kW	AGP SOHC SDi 50kW
Capacity (cm ³) / cylinders.....	1896 / 4	1896 / 4	1896 / 4	1896 / 4
Compression ratio / pressure.....bar	22.5 / ≥26.0	19.5 / ≥27.0	19.5 / 25 to 31	19.5 / ≥19.0
Torque output.....Nm	150	202	235	133
Oil pressure.....idle [running] bar	[2.0]	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature.....°C	80	80	80	80
Valve clearances - inlet (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature.....°C	84 to 98	84 to 98	85	85
Radiator cap pressure.....bar	1.4 to 1.6	1.4 to 1.6	1.4 to 1.6	1.4 to 1.6
Fuel system				
Idle speed.....rpm	900 ± 30	860 to 940	900 ± 30	875 to 1000
Maximum (no load) speed.....rpm	5200 ± 100	5200	5200	5150
Smoke test/opacity.....M ⁻¹ %	2.0	2.0	2.0	2.0
Static timing method.....	-	Plunger travel	Refer to wsm	Refer to wsm
Timing dimension.....mm	-	0.7 ± 0.02	-	Computer controlled
Crankshaft position.....mm [°]	-	TDC	-	-
Turbo type / ref / pressure.....bar	0.6 to 0.83 bar	1.5 to 1.65 bar @ 3500 rpm	0.5 to 0.65 bar @ 3500 to 4000	-
Injection pump make.....	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	-	VER 510	VER510 0460 404 986	-
Injector Make / type.....	-	Bosch	Bosch	-
Injector part no.....	-	0432 193 838	0432 193 838	-
Injection type.....	Indirect	Direct VER	Direct VER	SDi
Injection opening pressure, New [used]...bar	150 to 158 [≥140]	190 to 200 [≥170]	190 to 200 [170]	190 to 200 [170]
Glow plugs				
Maker.....	-	Bosch	Bosch	Champion
Type.....	-	0250 202 009	0250 202 009	CH171
Nominal rating.....V/A	-	11.5 / 12	11 / 12	11 /
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	7.0 with backing
Rear.....mm	2.5	2.5	2.5	7.0 with backing
Tyres - Saloon / Hatch.....Size	175/70x13:185/60x14:195/50x15	175/70x13:185/60x14:195/50x15	175/70x13:185/60x14:195/50x15	185/60x14:195/50x15: 205/50x15
- Estate / Van.....Size	185/60x14:195/60x14:195/50x15	185/60x14:195/60x14:195/50x15	185/60x14:195/60x14:195/50x15	-
Pressure - front / rear - Saloon / Hatch...bar	2.1 / 1.9 Vento: 2.0 / 1.8	2.1 / 1.9 Vento: 2.0 / 1.8	2.1 / 1.9 Vento: 2.0 / 1.8	-
- Estate / Van.....bar	2.1: 1.8: 2.1 / 2.1: 1.8: 2.1	2.1 / 2.1: 1.8 / 1.8: 2.1 / 2.1	2.1 / 2.1: 1.8 / 1.8: 2.1 / 2.1	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 10°]	[0° ± 10°]	[0° ± 10°]	[0° ± 10°]
Camber.....	-36' ± 20'	-36' ± 20'	-36' ± 20'	-30' ± 30'
Castor.....	1°50' ± 30'	1°50' ± 30'	1°50' ± 30'	7°40' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[20' ± 10°]	[20' ± 10°]	[20' ± 10°]	[20' ± 10°]
Camber.....	-1°30' ± 10	-1°30' ± 10	-1°30' ± 10'	-1°27' ± 10'



VOLKSWAGEN

Golf / Vento 1.9 TD
1995 to 1997

Golf / Vento 1.9 TD
1994 to 1998

Golf / Vento 1.9 TDi
1996 to 1998

Golf / Bora 1.9 SDi
1998 to 2000

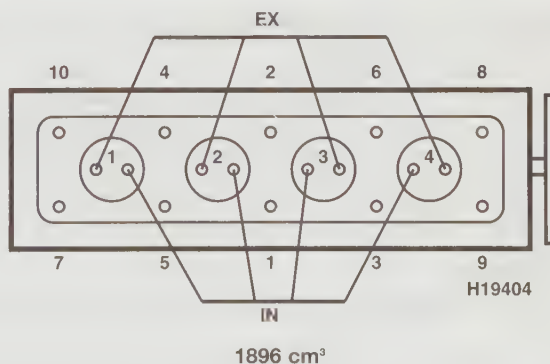
Torque wrench settings

Cylinder head - stage 1.....Nm	40 N	40 N	40 N	40 N
- stage 2.....Nm	60	60	60	60
- stage 3.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	30 + 90° N	30 + 90° N	30 + 90° N	30 + 90° N
Main bearings.....Nm	65 + 90° N	65 + 90° N	65 + 90° N	65 + 90° N
Crankshaft pulley bolt.....Nm	90 + 120° N	90 + 120° N	90 + 120° N	120 + 90° N
Camshaft pulley bolt.....Nm	80	80	80	45
Flywheel [driveplate] bolt.....Nm	60 + 90° N	60 + 90° N	60 + 90° N	60 + 90° [30] N
Front hubs.....Nm	265	265	265	300, slacken, 50 + 30°
Rear hubs.....Nm	WSM	WSM	WSM	175
Wheel nuts / bolts.....Nm	110	110	110	120
Glow plugs.....Nm	25	25	25	15
Clutch pressure plate bolts.....Nm	25	25	25	-
Injection pump sprocket.....Nm	-	55	55	20 + 90° N
Injectors.....Nm	70	20	20	20
Injection pump mounting bolts.....Nm	-	25	25	25
Injector pipe unions.....Nm	-	25	25	25

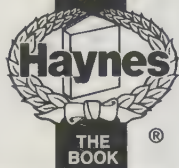
Capacities

Engine oil & filter.....litres	4.3	4.5	4.3	4.5
Gearbox.....litres	2.0	2.0	1.9	-
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	6.5	5.6	6.5	6.0
Fuel tank.....litres	55 Est: 60	55 Est: 60	55 Est: 60	55

Notes

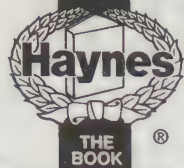


- Not applicable, or information not available



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	Golf / Bora 1.9 SDi 1998 to 2000	Golf / Bora 1.9 TDi 1998 to 2000	Golf / Bora 1.9 TDi 1998 to 1999	Golf / Bora 1.9 TDi 1999 to 2000
Engine				
Engine type/code	AQM SOHC SDi 50kW	AGR/ALH SOHC 8V Turbo 66kW	AHF SOHC Turbo 81kW	AJM SOHC 8V Turbo 85kW
Capacity (cm ³) / cylinders	1896 / 4	1896 / 4	1896 / 4	1896 / 4
Compression ratio / pressure	19.5 / ≥19.0	19.5 / 25 to 31	19.5 / 25 to 31	18.0 / ≥19.0
Torque output	133	210	235	285
Oil pressureidle [running] bar	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	85	85	85	85
Radiator cap pressurebar	1.4 to 1.6	1.4 to 1.6	1.4 to 1.6	1.4 to 1.6
Fuel system				
Idle speedrpm	-	875 to 950	875 to 950	875 to 950
Maximum (no load) speedrpm	-	4800 to 5200	4800 to 5200	4800 to 5200
Smoke test/opacityM-1 %	2.0	2.0	2.0	2.0
Static timing method	Refer to wsm	Refer to wsm	Refer to wsm	Refer to wsm
Timing dimension.....mm	Computer controlled	Computer controlled	Computer controlled	-
Crankshaft positionmm [°]	-	-	-	-
Turbo type / ref / pressurebar	-	1.7 to 2.2 bar @ 3000 rpm	1.7 to 2.2 bar 3000 rpm	-
Injection pump make	-	Bosch	Bosch	Bosch
Injection pump part no.....	-	VE	VE	-
Injector Make / type	-	-	-	-
Injector part no.....	-	-	-	-
Injection type.....	SDi	Direct VE	Direct	Direct Pump Injector
Injection opening pressure, New [used]...bar	-	190 to 200 [≥170]	190 to 200 [≥170]	190 to 200 [≥170]
Glow plugs				
Maker	Champion	Champion	Champion	-
Type	CH171	CH171	CH171	-
Nominal ratingV/A	11 /	11 /	11 /	-
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	7.0 with backing
Rear.....mm	7.0 with backing	7.0 with backing	7.0 with backing	7.0 with backing
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185/60x14:195/50x15: 205/50x15	185/60x14:195/50x15: 205/50x15	185/60x14:195/50x15: 205/50x15	195/65x15: 205/60x15:205/55x15
Pressure - front / rear - Saloon / Hatch...bar	-	2.0 / 1.8	2.0 / 1.8	-
- Estate / Vanbar	-	-	-	1.9 / 1.9
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0 ± 10°]	[0° ± 10°]	[0° ± 10°]	[0° ± 10°]
Camber	-30' ± 30'	-30' ± 30'	-30' ± 30'	-30' ± 30'
Castor	7° 40' ± 30'	7°40' ± 30'	7°40' ± 30'	7°40' ± 30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[20' ± 10°]	[20' ± 10°]	[20' ± 10°]	[20' ± 10°]
Camber	-1° 27' ± 10'	-1°27' ± 10'	-1°27' ± 10'	-1°27' ± 10'



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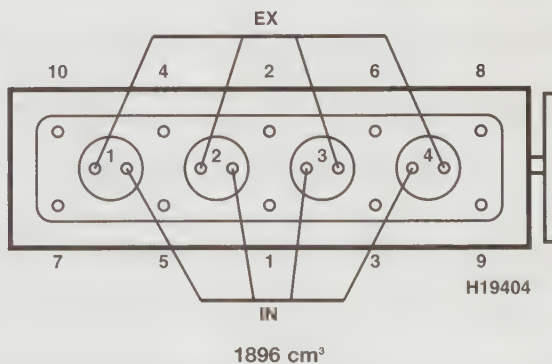
	Golf / Bora 1.9 SDi 1998 to 2000	Golf / Bora 1.9 TDi 1998 to 2000	Golf / Bora 1.9 TDi 1998 to 1999	Golf / Bora 1.9 TDi 1999 to 2000
Torque wrench settings				
Cylinder head - stage 1Nm	40 N	40 N	40 N	40 N
- stage 2Nm	60	60	60	60
- stage 3Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5Nm	–	–	–	–
- stage 6Nm	–	–	–	–
Big-end bearingsNm	30 + 90° N	30 + 90° N	30 + 90° N	30 + 90° N
Main bearingsNm	65 + 90° N	65 + 90° N	65 + 90° N	65 + 90° N
Crankshaft pulley boltNm	120 + 90° N	120 + 90° N	120 + 90° N	120 + 90° N
Camshaft pulley boltNm	45	45	45	100
Flywheel [driveplate] boltNm	60 + 90° [30] N	60 + 90° N [30]	60 + 90° N	60 + 90° N [30]
Front hubsNm	300, slacken, 50 + 30°	300, slacken, 50 + 30°	300, slacken, 50 + 30°	300, slacken, 50 + 30°
Rear hubsNm	175	175	175	175
Wheel nuts / boltsNm	120	120	120	120
Glow plugsNm	15	15	15	15
Clutch pressure plate boltsNm	–	20	13	20
Injection pump sprocketNm	20 + 90° N	20 + 90° N	20 + 90° N	20 + 90° N
InjectorsNm	20	20	20	–
Injection pump mounting boltsNm	25	25	25	25
Injector pipe unionsNm	25	25	25	25
Capacities				
Engine oil & filterlitres	4.5	4.5	4.5	4.5
Gearboxlitres	–	2.0	2.0	2.0 ¹
Automatic transmissionlitres	–	3.0	–	3.0
Final drivelitres	WT	WT Auto: 0.75	WT	WT Auto: 0.75 ²
Cooling systemlitres	6.0	6.0	6.0	6.0
Fuel tanklitres	55	55	55	55

Notes

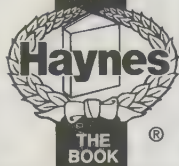
Golf / Bora 1.9 TDi 1999 to 2000

¹4motion: 2.6

²4motion: 1.0 Haldex coupling: 0.25 (drain and refill)



– Not applicable, or information not available



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	Passat 1.6 TD 1988 to 1992	Passat 1.9 D 1989 to 1993	Passat 1.9 TD CAT 1991 to 1993	Passat 1.9 TD 1993 to 1996
Engine				
Engine type/code.....	RA / SB SOHC Turbo 59kW	1Y SOHC 50kW	AAZ SOHC Turbo 55kW	AAZ SOHC Turbo 55kW
Capacity (cm ³) / cylinders.....	1588 / 4	1896 / 4	1896 / 4	1896 / 4
Compression ratio / pressurebar	23.0 / 26 to 34	23.0 / ≥26.0	22.5 / 26 to 34	22.5 / 26 to 34
Torque outputNm	0	0	150	150
Oil pressureidle [running] bar	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	87	87	87	87 to 102
Radiator cap pressurebar	1.2 to 1.5	1.2 to 1.5	1.2 to 1.5	1.3 to 1.5
Fuel system				
Idle speedrpm	900 ± 30	900 ± 30	900 ± 30	900 ± 30
Maximum (no load) speedrpm	5100 ± 50	5050 ± 100	5050 ± 100	5200 ± 100'
Smoke test/opacityM ⁻¹ %	2.5	2.0	2.0	2.0
Static timing method.....	Plunger travel	Plunger travel	Plunger travel	Dial gauge
Timing dimension.....mm	SB: 0.9 ± 0.02'	1.0 ± 0.02	0.9 ± 0.02	0.9 ± 0.02
Crankshaft positionmm [°]	[0] TDC	[0] TDC	[0] TDC	[0] TDC
Turbo type / ref / pressurebar	0.63 to 0.83 bar	—	0.6 to 0.83 bar	0.6 to 0.83 bar
Injection pump make.....	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VE4/9	VE4/8F	VE4/9 R420	VE R420
Injector Make / type.....	Bosch	Bosch	Bosch	Bosch
Injector part no.....	0432 217 165	0432 217 210	0432 217 232	0432 217 232
Injection type.....	Indirect VE	Indirect VE	Indirect VE	Indirect
Injection opening pressure, New [used]...bar	155 [140]	130 to 138 [120]	155 [140]	150 to 158 [140]
Glow plugs				
Maker.....	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type.....	0250 201 032 / CH69	0250 201 032 / CH69	0250 201 032 / CH69	0250 201 032 / CH160
Nominal rating.....V/A	11 / 12	—	11.5 / 8	11.5 / 8
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	7.0 with backing
Rear.....mm	2.5	2.5	2.5	2.5
Tyres - Saloon / Hatch.....Size	185/65x14: 195/60x14	185/65x14: 195/60x14	185/65x14: 195/60x14	185/65x14:195/60x14:205/50x15
- Estate / Van.....Size	185/65x14: 195/60x14	185/65x14: 195/60x14	185/65x14: 195/60x14	185/65x14:195/60x14:205/50x15
Pressure - front / rear - Saloon / Hatch...bar	2.0 / 2.0	2.0 / 2.0	2.0 / 2.0	2.1 / 2.1
- Estate / Van.....bar	2.0 / 2.0	2.0 / 2.0	2.0 / 2.0	2.0 / 2.0
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 10']	[0° ± 10']	[0° ± 10']	[0° ± 10']
Camber.....	-1°20' ± 20'	-1°20' ± 20'	-1°20' ± 20'	-1°20' ± 20'
Castor.....	1°40' ± 30'	1°40' ± 30'	1°40' ± 30'	1°40' ± 30'
King pin inclination.....	—	—	—	—
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[25' ± 15'] ²	[25' ± 15'] ¹	[25' ± 15'] ¹	[20' ± 10']
Camber.....	-1°40' ± 20' ³	-1°40' ± 20' ²	-1°40' ± 20' ²	-1°30' ± 10'



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	Passat 1.6 TD 1988 to 1992	Passat 1.9 D 1989 to 1993	Passat 1.9 TD CAT 1991 to 1993	Passat 1.9 TD 1993 to 1996
Torque wrench settings				
Cylinder head - stage 1	40 Nm	40 Nm	40 Nm	40 Nm
- stage 2	60	60	60	60
- stage 3	+ 180°	+ 180°	+ 180°	+ 90°
- stage 4	Warm up	Warm up	Warm up	+ 90°
- stage 5	+ 90°	+ 90°	+ 90°	-
- stage 6	+ 90° ⁴	-	-	-
Big-end bearings	30 + 180° N	30 + 90° N	30 + 90° N	30 + 90° oiled N
Main bearings	65	65	65	65 + 90° N
Crankshaft pulley bolt	180° ⁵	90 + 180°	90 + 180° N	90 + 90° oiled N
Camshaft pulley bolt	45	45	45	45
Flywheel [driveplate] bolt	30 + 90°	30 + 90°	30 + 90°	60 N
Front hubs	265	265	265	265
Rear hubs	WSM	WSM	WSM	WSM
Wheel nuts / bolts	110	110	110	110
Glow plugs	30	30	30	25
Clutch pressure plate bolts	20	20	20	20
Injection pump sprocket	45	45	45	45
Injectors	70	70	70	70
Injection pump mounting bolts	25	25	25	25
Injector pipe unions	25	25	25	25
Capacities				
Engine oil & filter	3.5 litres	4.5	4.5	4.5
Gearbox	2.0 litres	2.0	2.0	2.0
Automatic transmission	-	-	-	-
Final drive	WT	WT	WT	WT
Cooling system	6.5 litres	6.5	6.5	6.5
Fuel tank	70 litres	70	70	70

Notes

Passat 1.6 TD 1988 to 1992

¹RA: 1.0 ± 0.02

²Chassis no. 31LE222 111 or 31LB108 393 ►:

[20' ± 10']

³From chassis no. 31LE222 111 or 31LB108 393: -

1°30' ± 10'

⁴After 1000km

⁵Double hex bolt: 90 + 180°

Passat 1.9 D 1989 to 1993

¹Chassis no. 31LE222 111 or 31LB108 393 ►:

[20' ± 10']

²From chassis no. 31LE222 111 or 31LB108 393: -

1°30' ± 10'

Passat 1.9 TD CAT 1991 to 1993

¹Chassis no. 31LE222 111 or 31LB108 393 ►:

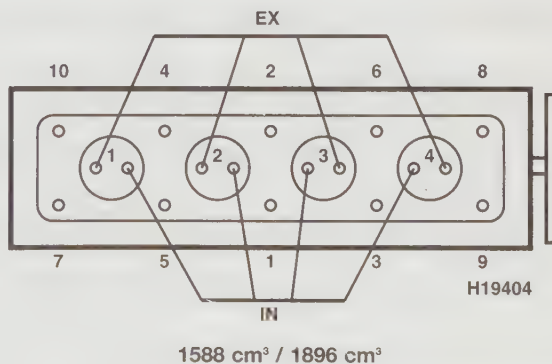
[20' ± 10']

²From chassis no. 31LE222 111 or 31LB108 393: -

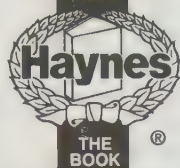
1°30' ± 10'

Passat 1.9 TD 1993 to 1996

² piece injection pump sprocket: 5050 ± 100



- Not applicable, or information not available



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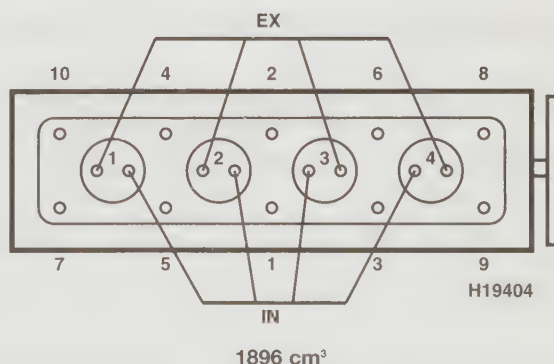
	Passat 1.9 TDi 1993 to 1996	Passat 1.9 TDi 1997 to 2000	Passat 1.9 TDi 1997 to 2000	Passat 1.9 TDi 1997 to 1999
Engine				
Engine type/code	1Z SOHC Turbo 66kW	AHU SOHC Turbo 66kW	AHH SOHC Turbo 66kW	AFN SOHC 8V Turbo 81kW
Capacity (cm ³) / cylinders	1896 / 4	1896 / 4	1896 / 4	1896 / 4
Compression ratio / pressure	19.5 / ≥27.0	21.0 / ≥19.0	19.5 / ≥19.0	19.5 / ≥19.0
Torque outputNm	202	202	210	235
Oil pressureidle [running] bar	[2.0 @ 2000]	1.0 to 2.5 [3.0 to 5.0]	[2.0 @ 2000]	1.0 to 2.5 [3.0 to 5.0]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	87 to 102	85	85	85
Radiator cap pressurebar	1.3 to 1.5	1.3 to 1.5	1.4 to 1.6	1.2 to 1.5
Fuel system				
Idle speedrpm	900 ± 40	780 to 900	795 to 910	835 to 910
Maximum (no load) speedrpm	5050	5200	5100	4800 to 5200
Smoke test/opacityM ⁻¹ %	2.0	2.0	2.0	2.0
Static timing method	Refer to wsm	Refer to wsm	Refer to wsm	Plunger travel
Timing dimension.....mm	-	-	-	0.70 ± 0.02
Crankshaft positionmm [°]	-	-	-	TDC
Turbo type / ref / pressurebar	0.5 to 0.65 bar @ 3500 rpm	-	1.8 to 2.05 bar @ 3000 rpm	-
Injection pump make	Bosch	Bosch	-	Bosch
Injection pump part no.....	VE R510	-	-	-
Injector Make / type	Bosch	Bosch	-	Bosch
Injector part no.....	0432 193 838	-	-	-
Injection type.....	Direct EDC VE	Direct	Direct EDC	Direct EDC
Injection opening pressure, New [used]...bar	190 to 200 [170]	190 to 200 [170]	220 to 230 [200]	190 to 200 [170]
Glow plugs				
Maker	Bosch	Bosch	-	Bosch
Type	0250 202 009	0250 202 022	-	0250 202 022
Nominal rating.....V/A	11.5 / 8	11.5 / 8	-	11.5 / 8
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0	7.0 with backing	7.0
Rear.....mm	2.5	7.0	7.0 with backing	7.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185/65x14:195/60x14:205/50x15	195/65x15: 205/60x16:205/55x16	195/65x15: 205/60x15	195/65x15: 205/60x16:205/55x16
- Estate / Van.....Size	185/65x14:195/60x14:205/50x15	195/65x15: 205/60x16:205/55x16	195/65x15: 205/60x15	-
Pressure - front / rear - Saloon / Hatch...bar	2.1 / 2.1	2.0 / 2.0	2.1 / 2.1	2.0 / 2.0
- Estate / Vanbar	2.0 / 2.0	2.1 / 2.1	2.1 / 2.2	-
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 10°]	[0°10' ± 20°]	[-0°10' ± 2°]	[0°10' ± 20°]
Camber	-1°20' ± 20'	-0°25' ± 25' Sport -0°40'±25'	-0°25' ± 25'	-0°25' ± 25' Sport: -0°40'±25'
Castor	1°40' ± 30'	-	-	-
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[20° ± 10°]	[0°20' ± 10°]	[-0°20' ± 10°]	[0°20' ± 10°]
Camber	-1°30' ± 10°	-1°30' ± 20°	-1°30' ± 20°	-1°30' ± 20°



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	Passat 1.9 TDi 1993 to 1996	Passat 1.9 TDi 1997 to 2000	Passat 1.9 TDi 1997 to 2000	Passat 1.9 TDi 1997 to 1999
Torque wrench settings				
Cylinder head - stage 1.....Nm	40 N	40 N	40 N	40 N
- stage 2.....Nm	60	60	60	60
- stage 3.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	30 + 90° oiled N	30 + 90° N	30 + 90° N	30 + 90° N
Main bearings.....Nm	65 + 90° N	65 + 90° N	65 + 90° N	65 + 90° N
Crankshaft pulley bolt.....Nm	90 + 90° oiled N	90 + 90° N	-	90 + 90° N
Camshaft pulley bolt.....Nm	80	45	45	45
Flywheel [driveplate] bolt.....Nm	60 N	60 + 90° N	60 + 90° N	60 + 90° N
Front hubs.....Nm	265	115 + 180°N M16: 140 + 180°N	115 + 180°N M16: 190 + 180°	115 + 180°N M16: 140 + 180°N
Rear hubs.....Nm	WSM	WSM	WSM	WSM
Wheel nuts / bolts.....Nm	110	120	120	120
Glow plugs.....Nm	30	15	15	15
Clutch pressure plate bolts.....Nm	20	20	20	20
Injection pump sprocket.....Nm	55	45	20 + 90° N	45
Injectors.....Nm	20	-	20	20
Injection pump mounting bolts.....Nm	25	25	25	25
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	4.5	4.3	4.3	4.3
Gearbox.....litres	2.0	2.25	2.25	2.25
Automatic transmission.....litres	-	-	3.5	3.5
Final drive.....litres	WT	WT	WT AT: .75	WT AT: 0.75
Cooling system.....litres	6.5	7.5	7.5	7.5
Fuel tank.....litres	70	62	62	62

Notes

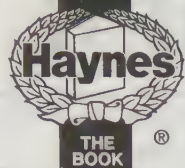


- Not applicable, or information not available



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	Passat 1.9 TDi 1999 to 2000	Passat 2.5 TDi 1999 to 2000	Sharan 1.9 TDi 1995 to 2000	Sharan 1.9 TDi 1999 to 2000
Engine				
Engine type/code.....	AJM SOHC 8V Turbo 85kW	AFB DOHC 24V Turbo 110kW	1Z / AHU SOHC 8V Turbo 66kW	ANU SOHC 8V 66kW
Capacity (cm ³) / cylinders.....	1896 / 4	2496 / 6	1896 / 4	1896 / 4
Compression ratio / pressure.....bar	18.0 / ≥19.0	19.5 / ≥24.0	21.0 / ≥19.0	18.0 / ≥19.0
Torque outputNm	285	310	202	240
Oil pressureidle [running] bar	[2.0 @ 2000]	0.8 [2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order.....	1-3-4-2	1-4-3-6-2-5	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	85	87	85 to 105	85 to 105
Radiator cap pressurebar	1.4 to 1.6	1.4 to 1.6	1.2 to 1.5	1.4 to 1.6
Fuel system				
Idle speedrpm	800 to 940	680 to 860	900 ± 40	800 to 940
Maximum (no load) speedrpm	4800 to 5200	4500 to 5500	-	5200
Smoke test/opacityM ⁻¹ %	2.0	2.0	2.0	2.0
Static timing method.....	Refer to wsm	Refer to wsm	Refer to wsm	-
Timing dimension.....mm	-	-	-	-
Crankshaft positionmm [°]	-	-	-	-
Turbo type / ref / pressure.....bar	1.7 to 2.2 bar at 3000 rpm	-	0.5 to 0.65 bar @ 3500 rpm	1.5 to 1.7 bar @ 3000 rpm
Injection pump make.....	-	Bosch	Bosch	-
Injection pump part no.....	-	-	VER510	-
Injector Make / type.....	-	-	Bosch	-
Injector part no.....	-	-	0432 193 838	-
Injection type.....	Direct Pump Injector EDC	Direct EDC	Direct VER	Direct unit injector
Injection opening pressure, New [used]...bar	190 to 200 [170]	180 to 190 [160]	190 to 200 [170]	190 to 200 [170]
Glow plugs				
Maker.....	-	-	Bosch	-
Type.....	-	-	0250 202 009	-
Nominal rating.....V/A	-	-	-	-
Brakes				
minimum friction material thickness				
Front.....mm	7.0	7.0	7.0 with backing	7.0 with backing
Rear.....mm	7.0	7.0	7.0 with backing	7.0 with backing
Tyres - Saloon / Hatch.....Size	195/65x15: 205/60x16:205/55x16	195/65x15: 205/60x15:205/55x16	-	-
- Estate / Van.....Size	-	-	195/65x15:205/60x15:215/60x15	195/65x15:205/60x15:215/60x15
Pressure - front / rear - Saloon / Hatch...bar	2.0 / 2.0	2.6 / 2.4	-	-
- Estate / Vanbar	-	-	2.6 / 2.6: 2.8 / 2.8: 2.8 / 2.6	2.6 / 2.6: 2.8 / 2.8: 2.8 / 2.6
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°10' ± 20°]	[0°10' ± 20°]	[10' ± 20°]	[10' ± 20°]
Camber.....	-0°25' ± 25' Sport: -0°40'±25'	-0°25' ± 25' Sport: -0°40'±25'	-20' ± 45'	-20' ± 45'
Castor.....	-	-	3°20' ± 40'	3°20' ± 40'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0°20' ± 10°]	[0°20' ± 10°]	[10' ± 25°] (not Nivomat)	[10' ± 25°] (not Nivomat)
Camber.....	-1°30' ± 20'	-1°30' ± 20'	-20' ± 30° (not Nivomat)	-20' ± 30° (not Nivomat)



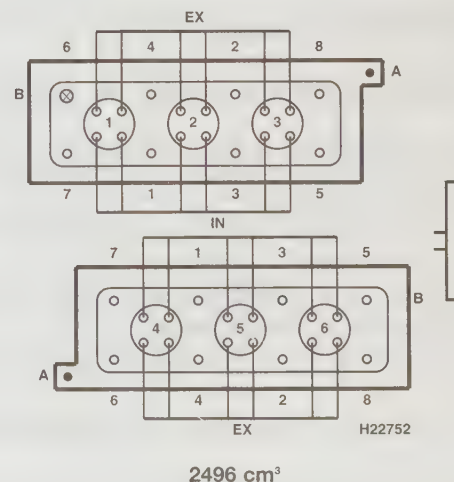
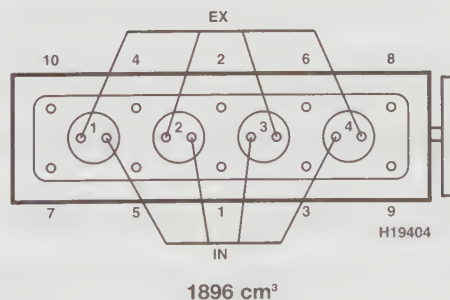
VOLKSWAGEN

	Passat 1.9 TDi 1999 to 2000	Passat 2.5 TDi 1999 to 2000	Sharan 1.9 TDi 1995 to 2000	Sharan 1.9 TDi 1999 to 2000
Torque wrench settings				
Cylinder head - stage 1Nm	40 N	35 N	40 N	40 N
- stage 2Nm	60	60	60	60
- stage 3Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5Nm	-	-	-	-
- stage 6Nm	-	-	-	-
Big-end bearings.....Nm	30 + 90° N	30 + 90° N	30 + 90° N	30 + 90° N
Main bearings.....Nm	65 + 90° N	WSM	65 + 90° N	65 + 90° N
Crankshaft pulley boltNm	120 + 90° N	200 + 180° N	90 + 90° N	120 + 90° N
Camshaft pulley boltNm	100	75	80	100
Flywheel [driveplate] bolt.....Nm	60 + 90° N [60 + 90° N]	60 + 180° N [60 + 90° N]	60 + 90° N	60 + 90° N
Front hubsNm	115 + 180° N M16: 140 + 180° N	115 + 180° N M16: 140 + 180° N	150 + 90° N	150 + 90° N
Rear hubsNm	WSM	WSM	200 N	200 N
Wheel nuts / boltsNm	120	120	140	140
Glow plugsNm	15	15	20	15
Clutch pressure plate boltsNm	20	-	25	20
Injection pump sprocket.....Nm	45	45	55	-
Injectors.....Nm	-	10	20	-
Injection pump mounting boltsNm	25	25	25	-
Injector pipe unions.....Nm	25	25	25	-
Capacities				
Engine oil & filter.....litres	3.8	5.4	4.7	4.5
Gearbox.....litres	2.25	2.4	2.2	2.2
Automatic transmissionlitres	3.5	-	-	-
Final drive.....litres	WT AT: 0.75	WT	WT	WT
Cooling system.....litres	7.0	10.0	7.0 2 heat exchangers: 9.0	6.8 2 heat exchangers: 8.6 ¹
Fuel tank.....litres	62	62	70	70

Notes

Sharan 1.9 TDi 1999 to 2000

¹Two heat exchangers and additional water heater:
9.2 L



- Not applicable, or information not available



VOLKSWAGEN

	Sharan 1.9 TDi 1996 to 2000	Caddy 1.6 D 1985 to 1992	Caddy Pick-Up 1.9 D 1997 to 2000	Taro 2.4 D 4x4 1989 to 1994
Engine				
Engine type/code.....	AFN SOHC 8V Turbo 81kW	JK SOHC 40kW	AEF SOHC 47kW	2L OHC 61kW
Capacity (cm ³) / cylinders.....	1896 / 4	1588 / 4	1896 / 4	2446 / 4
Compression ratio / pressurebar	19.5 / 25 to 31	23.0 / ≥28.0	22.5 / ≥26.0	22.2 / ≥20.0
Torque outputNm	235	0	124	0
Oil pressureidle [running] bar	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]	[3.0 to 5.5 @ 3000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0: Hyd.	0.25 H	0: Hyd.	0.20 to 0.30
- exhaust (mm).....	0: Hyd.	0.45 H	0: Hyd.	0.40 to 0.50
Injection order.....	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
No. 1 cylinder position.....	TBE	TBE	TBE	F
Cooling system				
Thermostat opening temperature°C	85 to 105	87	88	84 to 90
Radiator cap pressurebar	1.4 to 1.6	1.2 to 1.4	0.9 to 1.1	0.8 to 1.1
Fuel system				
Idle speedrpm	900 ± 40	850 ± 30	920 to 960	700
Maximum (no load) speedrpm	5200	5350 ± 50	4950 to 5150	-
Smoke test/opacityM ⁻¹ %	2.0	2.0	2.5	2.5
Static timing method.....	Refer to wsm	Plunger travel	Refer to wsm	Plunger travel
Timing dimension.....mm	-	0.9 ± 0.02	-	0.54 to 0.66
Crankshaft positionmm [°]	-	[0] TDC	-	[0] TDC
Turbo type / ref / pressurebar	0.5 to 0.65 bar @ 3500 rpm	-	-	-
Injection pump make.....	Bosch	Bosch	Lucas	Nippon Denso
Injection pump part no.....	VER 510	VE4/9 0460 494 052	DPC	J22 100 547 5 or 547 60
Injector Make / type.....	-	Bosch	-	Nippon Denso
Injector part no.....	-	0432 217 084	-	DN4PD57
Injection type.....	Direct VER	Indirect VE	Indirect DPC	Bosch type
Injection opening pressure, New [used]...bar	190 to 200 [170]	130 to 138 [120]	130 to 138 [120]	151 [145]
Glow plugs				
Maker.....	Bosch	Bosch/Champion	Bosch	Beru
Type.....	0250 202 009	0250 201 032 / CH69	0250 202 022	GV968
Nominal rating.....V/A	11 / 12	11 / 12	11.5 / 8	7.0 / -
Brakes				
minimum friction material thickness				
Front.....mm	7.0 with backing	7.0 with backing	7.0 with backing	1.0
Rear.....mm	7.0 with backing	3.5 Riveted: 5.0	2.5	1.0
Tyres - Saloon / Hatch.....Size	-	-	-	-
- Estate / Van.....Size	195/65x15:205/60x15:215/60x15	165x13	165/70x13	205x16
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	2.6 / 2.6: 2.8 / 2.8: 2.8 / 2.6	1.8 / 2.4	2.0 / 2.0	1.7 / 2.4
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[10' ± 20']	[-15' + 10' -15']	[-0°10' ± 10']	3.0 ± 1.0
Camber.....	-20' ± 45'	20' ± 30'	-0°30' ± 30'	30' ± 30'
Castor.....	3°20' ± 40'	1°50' ± 20'	1°20' ± 45'	1°10' ± 30'
King pin inclination.....	-	-	11°45' ± 45'	12°5' ± 45'
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[10' ± 25'] (not Nivomat)	[0° ± 1°]	[0°20' ± 10']	-
Camber.....	-20' ± 30' (not Nivomat)	0° ± 10'	1°30' ± 10'	-



VOLKSWAGEN

	Sharan 1.9 TDi 1996 to 2000	Caddy 1.6 D 1985 to 1992	Caddy Pick-Up 1.9 D 1997 to 2000	Taro 2.4 D 4x4 1989 to 1994
Torque wrench settings				
Cylinder head - stage 1Nm	40 N	M11 hex: 50 ¹	40 N	78 N
- stage 2Nm	60	70	60	+ 90°
- stage 3Nm	+ 90°	90	+ 90°	+ 90°
- stage 4Nm	+ 90°	Warm up, 90	+ 90°	-
- stage 5Nm	-	After 1000km:	-	-
- stage 6Nm	-	Slacken 30°, 90	-	-
Big-end bearings.....Nm	30 + 90° N	Thread length 15mm: 45 ² N	30 + 90° N	54 + 90° N
Main bearings.....Nm	65 + 90° N	65	65 + 90° N	103
Crankshaft pulley boltNm	90 + 90° N	Hexagon: 80°	90 + 90° oiled N	167
Camshaft pulley boltNm	80	45	20 + 90° N	98
Flywheel [driveplate] bolt.....Nm	60 + 90° N	30 + 90°	60 + 90° N	123 [98]
Front hubsNm	150 + 90° N	230	300	WSM
Rear hubsNm	200 N	WSM	WSM	-
Wheel nuts / boltsNm	140	110	110	140
Glow plugsNm	30	30	25	13
Clutch pressure plate boltsNm	20	20	25	19
Injection pump sprocket.....Nm	55	45	25	64
Injectors.....Nm	20	70	70	64
Injection pump mounting boltsNm	25	25	25	18
Injector pipe unions.....Nm	25	25	25	25
Capacities				
Engine oil & filter.....litres	4.3	4.5	4.7	5.9
Gearbox.....litres	2.2	1.5 [2.0]	2.4	3.9 ¹
Automatic transmissionlitres	-	-	-	-
Final drivelitres	WT	WT	WT	Front: 2.3 ²
Cooling system.....litres	7.0 2 heat exchangers: 9.0	6.5	6.0	9.2
Fuel tank.....litres	70	45	42	65

Notes

Caddy 1.6 D 1985 to 1992

¹M12 splined socket bolt: 40, 60, 75 + 180° Warm up, + 90°. After 1000km: + 90°

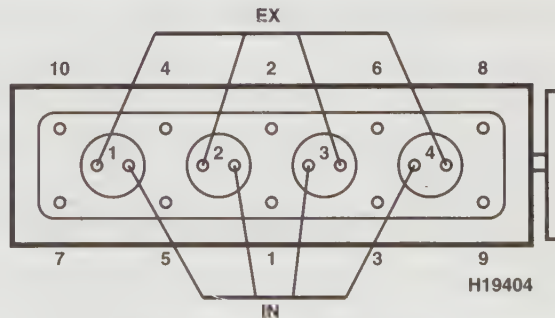
²Thread length 25mm: 30 + 90°

³Durlock M12: 150. Durlock M14: 200

Taro 2.4 D 4x4 1989 to 1994

¹W56 type: 3.0. Transfer box: 1.6

²Rear: 2.2. Independent front suspension: 1.6



1588 cm³ / 1896 cm³ / 2446 cm³



VOLKSWAGEN

	Transporter/Caravelle 1.6 TD 1984 to 1992	Transporter 1.9 D 1990 to 1992	Transporter 1.9 TD 1992 to 2000	Transporter/Caravelle 2.4D 1991 to 1998
Engine				
Engine type/code	JX SOHC Turbo 51kW	1X SOHC 45kW	ABL SOHC Turbo 50kW	AAB SOHC 10V 57kW
Capacity (cm ³) / cylinders	1588 / 4	1896 / 4	1896 / 4	2370 / 5
Compression ration / pressure	23.0 / ≥28.0	22.5 / ≥26.0	22.5 / ≥26.0	23.0 / ≥26.0
Torque outputNm	0	0	140	164
Oil pressureidle [running] bar	[1.1 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.15 to 0.20	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0.35 to 0.45	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-3-4-2	1-2-4-5-3
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	85	87	87	87 to 102
Radiator cap pressurebar	0.9 to 1.2	1.2 to 1.5	1.2 to 1.5	1.2 to 1.5
Fuel system				
Idle speedrpm	820 ± 50	850 ± 30	850 ± 30	850 ± 50
Maximum (no load) speedrpm	5100 ± 100	4800 ± 100	4800 ± 100	4800
Smoke test/opacityM ⁻¹ %	2.0	2.0	2.0	2.0
Static timing method	Plunger travel	Plunger travel	Plunger travel	Dial gauge
Timing dimension.....mm	0.9 ± 0.02	1.0 ± 0.02	1.0 ± 0.02	1.0 ± 0.02
Crankshaft positionmm [°]	[0] TDC	[0] TDC	[0] TDC	[0 TDC]
Turbo type / ref / pressurebar	0.62 to 0.72 bar	-	0.6 to 0.83 bar	-
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VE 4/9 0460 494 152	VE4/8 R357	VE 4/8 R357	VE 5/8 L358
Injector Make / type	Bosch	Bosch	Bosch	Bosch
Injector part no.....	0432 217 078	0432 217 198	0432 217 198	0432 217 198
Injection type.....	Indirect VE	Indirect VE	Indirect VE	Indirect VE
Injection opening pressure, New [used]...bar	155 [140]	130 to 138 [120]	155 to 163 [140]	130 to 138 [120]
Glow plugs				
Maker	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch/Champion
Type	0250 201 032 / CH69	0250 201 032 / CH160	0250 201 032 / CH160	0250 201 032 / CH160
Nominal rating.....V/A	11 / 12	11 / 12	11 / 8	11 / 12
Brakes				
minimum friction material thickness				
Front.....mm	2.0	7.0 with backing	7.0 with backing	2.0
Rear.....mm	2.5	2.5	2.5	1.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185x14	185x14: 195/70x15	185x14: 195/70x15	195/70x15:205/65x15:215/65x15
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	3.0 / 3.7	3.3 / 3.8 ¹	3.3 / 3.8 ¹	2.6 / 3.4. 215/65: 2.4 / 3.0
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 ± 3.5	Group 1 & 2: [40' ± 20'] ²	Group 1 & 2: [40' ± 20'] ²	Group 1 & 2: [20'±20'] ²
Camber	0° ± 30'	Group 1 & 2: 35' ± 20' ³	Group 1 & 2: 35' ± 20' ³	Group 1 & 2: 15'±20' ³
Castor	7°15' ± 15'	Group 1 & 2: 1°40' ± 30'	Group 1 & 2: 1°40' ± 30'	1°40'±30' Group 4: 1°50'±30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 20']	Group 1: [20' ± 20'] ⁴	Group 1: [20' ± 20'] ⁴	Group 1 & 3: [20'±20'] ⁴
Camber	-30' ± 30'	Group 1: -30' ± 30' ⁵	Group 1: -30' ± 30' ⁵	Group 1 & 3: -30'±30' ⁵



VOLKSWAGEN

	Transporter/Caravelle 1.6 TD 1984 to 1992	Transporter 1.9 D 1990 to 1992	Transporter 1.9 TD 1992 to 2000	Transporter/Caravelle 2.4D 1991 to 1998
Torque wrench settings				
Cylinder head - stage 1	M11 hex: 50'	40 N	40 N	40 N
- stage 2	70	60	60	60
- stage 3	90	+ 180°	+ 180°	+ 90°
- stage 4	Warm up, 90	Warm up	Warm up	+ 90°
- stage 5	After 1000km,	+ 90°	+ 90°	-
- stage 6	Slacken 30°, 90	-	-	-
Big-end bearings.....	Thread length 15mm: 45 ²	30 + 90° N	30 + 90° N	30 + 90° N
Main bearings.....	65	65	65 N	65 ⁵
Crankshaft pulley bolt	M14: 180°	90 + 90°	90 + 90° N	460
Camshaft pulley bolt	45	45	45	85
Flywheel [driveplate] bolt.....	30 + 90°	30 + 90°	30 + 90° N	30 + 90° N
Front hubs	WSM	200	200	150 + 90° N
Rear hubs	500	200	200	200
Wheel nuts / bolts	180	160	160	160
Glow plugs	30	30	30	30
Clutch pressure plate bolts	25	20	20	20
Injection pump sprocket.....	45	45	45	100 Pump end: 50
Injectors.....	70	70	70	70
Injection pump mounting bolts	25	20	20	20
Injector pipe unions.....	25	25	25	25
Capacities				
Engine oil & filter.....	litres 4.5	5.0	5.0	5.5
Gearbox.....	litres 4.0	3.0	3.0	2.5 4x4: 3.0
Automatic transmission	litres -	-	-	3.5
Final drive	litres WT	-	WT	WT AT: 1.15 4x4: 1.0
Cooling system.....	litres 16.0	9.0	9.0	9.0
Fuel tank.....	litres 60	80	80	80

Notes

Transporter / Caravelle 1.6 TD 1984 to 1992

*M12 splined socket bolt: 40, 60, 75 + 180° Warm up, + 90°. After 1000km: + 90°

*Thread length 25mm: 30 + 90°

*M12: 150. M14 12 point: 90 + 180°

Transporter 1.9 D 1990 to 1992

*195/70x15: 2.6 / 3.4

*Group 3: [30' ± 20']. Group 4: [20' ± 20']

*Group 3: 20' ± 20'. Group 4: 10' ± 20'

*Group 2: 6' ± 20'. Group 3: 20' ± 20'. Group 4: 24' ± 20'

*Group 2: 0 ± 30'. Group 3: -30' ± 30'. Group 4: -40' ± 30'

Transporter 1.9 TD 1992 to 2000

*195/70x15: 2.6 / 3.4

*Group 3: [30' ± 20']. Group 4: [20' ± 20']

*Group 3: 20' ± 20'. Group 4: 10' ± 20'

*Group 2: 6' ± 20'. Group 3: 20' ± 20'. Group 4: 24' ± 20'

*Group 2: 0 ± 30'. Group 3: -30' ± 30'. Group 4: -40' ± 30'

Transporter/Caravelle 2.4D 1991 to 1998

*Coolant temperature sender plug blue 2 pin disconnected

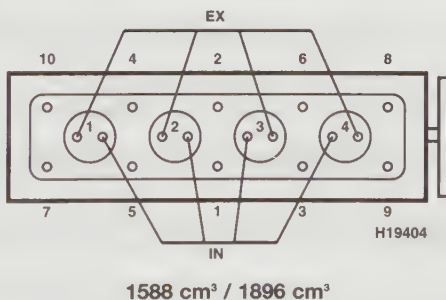
*Group 3: [10' ± 20']. Group 4: [0 ± 20']

*Group 3: 0 ± 20'. Group 4: -10' ± 20'

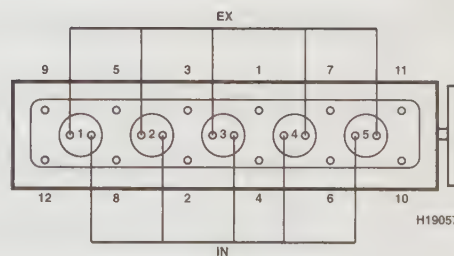
*Group 2: 6' ± 20'. Group 4: 24' ± 20'

*Group 2: 0 ± 30'. Group 4: -40' ± 30'

*Replace with fully threaded shank bolts: 65 + 90°



1588 cm³ / 1896 cm³



2370 cm³

- Not applicable, or information not available



VOLKSWAGEN

	Transporter/Caravelle 2.4D 1997 to 1998	Transporter/Caravelle 2.5TD 1997 to 2000	Transporter/Caravelle 2.5TD 1998 to 2000	Transporter/Caravelle 2.5TD 1998 to 2000
Engine				
Engine type/code	AJA SOHC 10V 55kW	ACV SOHC 10V Turbo 75kW	AHY SOHC 10V Turbo 111kW	AJT SOHC 10V Turbo 65kW
Capacity (cm ³) / cylinders	2370 / 5	2459 / 5	2459 / 5	2459 / 5
Compression ratio / pressure	23.0 / ≥26.0	20.5 / ≥24.0	19.5 / ≥24.0	19.5 / ≥24.0
Torque outputNm	164	250	295	195
Oil pressureidle [running] bar	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-2-4-5-3	1-2-4-5-3	1-2-4-5-3	1-2-4-5-3
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	87 to 102	87 to 102	87 to 102	87 to 102
Radiator cap pressurebar	1.2 to 1.5	1.2 to 1.5	1.2 to 1.5	1.2 to 1.5
Fuel system				
Idle speedrpm	850 ± 50	740 to 800	740 to 800	740 to 800
Maximum (no load) speedrpm	4800	4300 to 4700	-	-
Smoke test/opacityM ⁻¹ %	2.01	2.0	2.0	2.0
Static timing method	Dial gauge	Rotor lift	Plunger travel	Plunger travel
Timing dimension.....mm	0.9 ± 0.02	0.55	0.9 ± 0.02	0.9 ± 0.02
Crankshaft positionmm [°]	[0 TDC]	[0 TDC]	[0 TDC]	[0 TDC]
Turbo type / ref / pressurebar	-	1.7 to 1.95 bar @ 3000	1.75 to 2.08 bar @ 3000	1.5 to 1.8 bar @ 3000
Injection pump make	Bosch	Bosch	-	-
Injection pump part no.....	-	VE	-	-
Injector Make / type	Bosch	Bosch	-	-
Injector part no.....	-	-	-	-
Injection type.....	Indirect	Indirect VE	Indirect	Indirect
Injection opening pressure, New [used]...bar	130 to 138 [120]	130 to 138 [120]	130 to 138 [120]	130 to 138 [120]
Glow plugs				
Maker	Bosch/Champion	Bosch	Bosch/Champion	Bosch/Champion
Type	0250 201 032 / CH160	0250 202 022	W8DTC / N9BMC	W8DTC / N9BMC
Nominal rating.....V/A	11 / 12	11 / 12	-	-
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.0	2.0
Rear.....mm	1.0	1.0	1.0	2.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/70x15:205/65x15:215/65x15	195/70x15:205/65x15:215/65x15	195/70x15:205/65x15:215/65x15	195/70x15:205/65x15:215/65x15
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	2.6 / 3.4 215/65: 2.4 / 3.0	2.6 / 3.4 215/65: 2.4 / 3.0	2.6 / 3.4 215/65: 2.4 / 3.0	2.6 / 3.4 215/65: 2.4 / 3.0
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	Group 1 & 2: [20'±20'] ²	Group 1 & 2: [20' ± 20'] ²	Group 1 & 2: [20'±20'] ²	Group 1 & 2: [20'±20'] ²
Camber	Group 1 & 2: 15'±20' ³	Group 1 & 2: 15' ± 20' ³	Group 1 & 2: 15'±20' ³	Group 1 & 2: 15'±20' ³
Castor	1°40'±30' Group 4: 1°50'±30'	1°40' ± 30' Group 4: 1°50'±30	1°40'±30' Group 4: 1°50'±30'	1°40'±30' Group 4: 1°50'±30'
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	Group 1 & 3: [20'±20'] ⁴	Group 1 & 3: [20' ± 20'] ⁴	Group 1 & 3: [20'±20'] ⁴	Group 1 & 3: [20'±20'] ⁴
Camber	Group 1 & 3: -30'±30' ⁵	Group 1 & 3: -30' ± 30' ⁵	Group 1 & 3: -30'±30' ⁵	Group 1 & 3: -30'±30' ⁵



VOLKSWAGEN

	Transporter/Caravelle 2.4D 1997 to 1998	Transporter/Caravelle 2.5TD 1997 to 2000	Transporter/Caravelle 2.5TD 1998 to 2000	Transporter/Caravelle 2.5TD 1998 to 2000
Torque wrench settings				
Cylinder head - stage 1	Nm 40 N	40 N	40 N	40 N
- stage 2	Nm 60	60	60	60
- stage 3	Nm + 90°	+ 90°	+ 90°	+ 90°
- stage 4	Nm + 90°	+ 90°	+ 90°	+ 90°
- stage 5	Nm -	-	-	-
- stage 6	Nm -	-	-	-
Big-end bearings	Nm 30 + 90° N	30 + 90° N	30 + 90° N	30 + 90° N
Main bearings	Nm 65 ^a	65	65	65
Crankshaft pulley bolt	Nm 460 '95-on: 160 + 180° N	160 + 180° N	160 + 180° N	160 + 180° N
Camshaft pulley bolt	Nm 85	WSM	WSM	WSM
Flywheel [driveplate] bolt	Nm 30 + 90° N	60 + 90° N	60 + 90° N	60 + 90° N
Front hubs	Nm 150 + 90° N	150 + 90° N	150 + 90° N	150 + 90° N
Rear hubs	Nm 200	200	200	200
Wheel nuts / bolts	Nm 160	160	160 ¹	160
Glow plugs	Nm 30	15	15	15
Clutch pressure plate bolts	Nm 20	20	20	20
Injection pump sprocket	Nm 100 Pump end: 50	90	90	90
Injectors	Nm 70	70	70	70
Injection pump mounting bolts	Nm 20	20	20	20
Injector pipe unions	Nm 25	25	25	25
Capacities				
Engine oil & filter	litres 5.5	5.5	5.5	5.5
Gearbox	litres 2.5 4x4: 3.0	2.5 4x4: 3.0	2.5 4x4: 3.0	2.5 4x4: 3.0
Automatic transmission	litres 3.5	3.5	3.5	3.5
Final drive	litres WT AT: 1.15 4x4: 1.0	WT AT: 1.15 4x4: 1.0	WT AT: 1.15 4x4: 1.0	WT AT: 1.15 4x4: 1.0
Cooling system	litres 11.5	11.5	9.0	9.0
Fuel tank	litres 80	80	80	80

Notes

Transporter/Caravelle 2.4D 1997 to 1998

¹Coolant temperature sender plug blue 2 pin disconnected

^aGroup 3: [10°±20°]. Group 4: [0±20°]

^aGroup 3: 0±20°. Group 4: -10°±20°

^aGroup 2: 6°±20°. Group 4: 24°±20°

^aGroup 2: 0±30°. Group 4: -40°±30°

^aReplace with fully threaded shank bolts: 65 + 90°

Transporter/Caravelle 2.5TD 1997 to 2000

^aGroup 3: [10°±20°]. Group 4: [0±20°]

^aGroup 3: 0±20°. Group 4: -10°±20°

^aGroup 2: +6°±20°. Group 4: 24°±20°

^aGroup 2: 0±30°. Group 4: -40°±30°

Transporter/Caravelle 2.5TD 1998 to 2000

¹ Vehicles from 01.96: 180 Nm

^aGroup 3: [10°±20°]. Group 4: [0±20°]

^aGroup 3: 0±20°. Group 4: -10°±20°

^aGroup 2: 6°±20°. Group 4: 24°±20°

^aGroup 2: 0±30°. Group 4: -40°±30°

Transporter/Caravelle 2.5TD 1998 to 2000

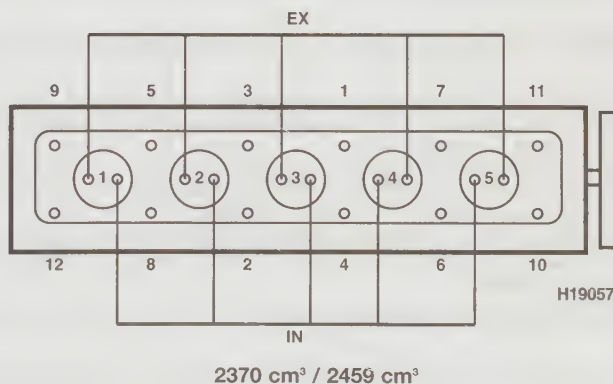
^aGroup 3: [10°±20°]. Group 4: [0±20°]

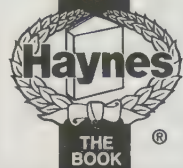
^aGroup 3: 0±20°. Group 4: -10°±20°

^aGroup 2: 6°±20°. Group 4: 24°±20°

^aGroup 2: 0±30°. Group 4: -40°±30°

– Not applicable, or information not available





VOLKSWAGEN

	LT 2.4 D 1989 to 1992	LT 2.4 TD 1989 to 1992	LT 2.4 D 1992 to 1996	LT 2.4 TD 1992 to 1996
Engine				
Engine type/code	1S SOHC 51kW	1G SOHC Turbo 68kW	ACT SOHC 51kW	ACL SOHC Turbo 70kW
Capacity (cm ³) / cylinders	2383 / 6	2383 / 6	2383 / 6	2383 / 6
Compression ratio / pressure	23.0 / ≥26.0	23.0 / ≥26.0	23.0 / 26 to 35	23.0 / 26 to 35
Torque outputNm	0	0	145	205
Oil pressureidle [running] bar	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm)	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
No. 1 cylinder position	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	80	80	80	80
Radiator cap pressurebar	1.2 to 1.5	1.2 to 1.5	1.2 to 1.5	1.2 to 1.5
Fuel system				
Idle speedrpm	750 ± 50	750 ± 50	750 ± 50	750 ± 50
Maximum (no load) speedrpm	5000 ± 50	4900	4800	4500
Smoke test/opacityM ⁻¹ %	2.0	2.0	2.5	2.5
Static timing method	Plunger travel	Plunger travel	Dial gauge	Dial gauge
Timing dimension.....mm	0.8 ± 0.02	0.85 ± 0.02	0.8 ± 0.02	0.85 ± 0.02
Crankshaft positionmm [°]	[0] TDC	[0] TDC	0 TDC	0 TDC
Turbo type / ref / pressurebar	—	0.64 to 0.76 bar @ 4000 rpm	—	—
Injection pump make	Bosch	Bosch	Bosch	Bosch
Injection pump part no.....	VE 6/10F	VE6/10 L324	VE6/10F	VE6/10 L470
Injector Make / type	Bosch	Bosch	Bosch	Bosch
Injector part no.....	0432 217 198	0432 217 079	0432 217 198	0432 217 231
Injection type.....	Indirect VE	Indirect VE	Indirect VE	Indirect VE
Injection opening pressure, New [used]...bar	130 to 138 [120]	155 to 163 [140]	130 to 138 [120]	155 to 163 [140]
Glow plugs				
Maker	Bosch/Champion	Bosch/Champion	Bosch/Champion	Bosch
Type	0250 201 032 / CH69	0250 201 032 / CH69	0250 201 021 / CH69	0250 201 032
Nominal ratingV/A	11 / 12	11.5 / 12	11 / 12	11.5 / 8
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	2.5	2.5
Rear.....mm	2.5	2.5	2.5	2.5
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	185x14: 195x14: 205x14	185x14: 195x14: 205x14	205x14	205x14
Pressure - front / rear - Saloon / Hatch...bar	—	—	—	—
- Estate / Vanbar	Refer to manufacturer / ohb	Refer to manufacturer / ohb	3.0 / 4.5	3.0 / 4.5
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	3.0 to 6.0'	3.0 to 6.0'	3.0 to 6.0	3.0 to 6.0
Camber	40' ± 20' ²	40' ± 20' ²	0°40' ± 20'	0°40' ± 20'
Castor	40' ± 20' ³	40' ± 20' ³	2°30' ± 40	2°30' ± 40
King pin inclination.....	—	—	—	—
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[20' ± 40'] ⁴	[20' ± 40'] ⁴	[0° ± 20']	[0° ± 20']
Camber	0° ± 25'	0° ± 25'	0°25'	0°25'



VOLKSWAGEN

	LT 2.4 D 1989 to 1992	LT 2.4 TD 1989 to 1992	LT 2.4 D 1992 to 1996	LT 2.4 TD 1992 to 1996
Torque wrench settings				
Cylinder head - stage 1Nm	M11 hex: 50 ^a	M11 hex: 50 ^a	40 N M11: ¹	40 N M11: ¹
- stage 2Nm	70	70	60	60
- stage 3Nm	90	90	+ 180°	+ 180°
- stage 4Nm	Warm up, 90	Warm up, 90	-	-
- stage 5Nm	After 1000km,	After 1000km,	-	-
- stage 6Nm	Slacken 30°, 90	Slacken 30°, 90	-	-
Big-end bearingsNm	Thread length 15mm: 50 ^a	Thread length 15mm: 50 ^a	30 + 180° N	30 + 180° N
Main bearingsNm	65	65	65	65
Crankshaft pulley boltNm	460	460	460	460
Camshaft pulley boltNm	85 Pump end: 100	85 Pump end: 100	85	85
Flywheel [driveplate] boltNm	70 + 90°	70 + 90°	60 + 90° N	60 + 90° N
Front hubsNm	WSM	WSM	WSM	WSM
Rear hubsNm	WSM	WSM	WSM	WSM
Wheel nuts / boltsNm	320 LT 28/31: 300	320 LT 28/31: 300	200	200
Glow plugsNm	20	20	30	30
Clutch pressure plate boltsNm	25	25	25	25
Injection pump sprocketNm	45	45	50	50
InjectorsNm	70	70	70	70
Injection pump mounting boltsNm	25	25	25	25
Injector pipe unionsNm	25	25	25	25
Capacities				
Engine oil & filterlitres	7.0	7.0	7.0	7.0
Gearboxlitres	3.5	3.5	3.5	3.5
Automatic transmissionlitres	-	-	-	-
Final drivelitres	1.8 Twin tyres:2.4	1.8 Twin tyres:2.4	1.8	1.8
Cooling systemlitres	12.0	12.0	12.0	12.0
Fuel tanklitres	70 Option: 110	70 Option: 110	70	70

Notes

LT 2.4 D 1989 to 1992

¹LT 40, 45, 50, 55: 0 to +2.2

²LT 40, 45, 50, 55: +10°±35°

³LT 40, 45, 50, 55: +3°25'±20°

⁴LT 40, 45, 50, 55: [0±20°]

^aM12 splined socket bolt: 40, 60 + 180°. Warm up + 90°. After 1000km, + 90°

^aThread length 25mm: 30 + 180°

LT 2.4 TD 1989 to 1992

¹LT 40, 45, 50, 55: 0 to +2.2

²LT 40, 45, 50, 55: +10°±35°

³LT 40, 45, 50, 55: +3°25'±20°

⁴LT 40, 45, 50, 55: [0±20°]

^aM12 splined socket bolt: 40, 60 + 180°. Warm up + 90°. After 1000km, + 90°

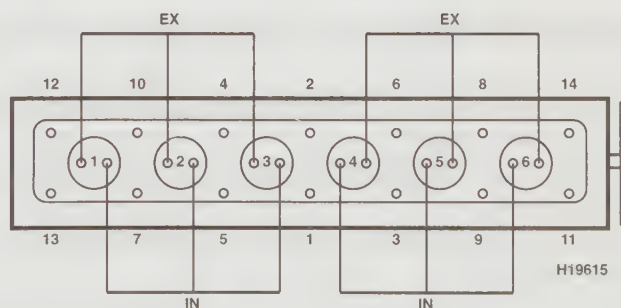
^aThread length 25mm: 30 + 180°

LT 2.4 D 1992 to 1996

¹ M11: 50 N, 70, 90, warm up, 90

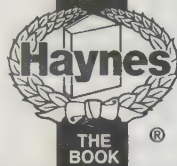
LT 2.4 TD 1992 to 1996

¹ M11: 50 N, 70, 90, warm up, 90



2383 cm³

– Not applicable, or information not available



VOLKSWAGEN

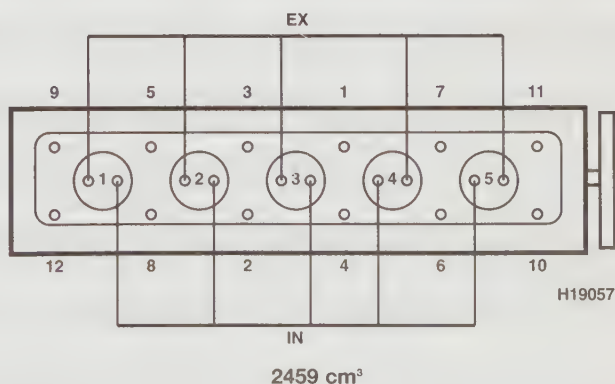
	LT 2.5 D 1996 to 1999	LT 2.5 TDi 1997 to 1999	LT 2.5 TDi 1999 to 2000	LT 2.5 TDi 1999 to 2000
Engine				
Engine type/code.....	AGX SOHC 55kW	AHD SOHC Turbo 75kW	ANJ SOHC Vari - Turbo 80kW	APA SOHC Turbo 66kW
Capacity (cm ³) / cylinders.....	2459 / 5	2459 / 5	2459 / 5	2459 / 5
Compression ratio / pressure.....bar	19.5 / ≥24.0	19.5 / ≥24.0	19.0 / ≥24.0	19.5 / ≥24.0
Torque outputNm	160	250	275	195
Oil pressureidle [running] bar	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]	[2.0 @ 2000]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
- exhaust (mm).....	0: Hyd.	0: Hyd.	0: Hyd.	0: Hyd.
Injection order.....	1-2-4-5-3	1-2-4-5-3	1-2-4-5-3	1-2-4-5-3
No. 1 cylinder position.....	TBE	TBE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	87	87	87	87
Radiator cap pressurebar	1.2 to 1.5	1.2 to 1.5	1.2 to 1.5	1.2 to 1.5
Fuel system				
Idle speedrpm	740 to 800	755 to 830	730 to 830	730 to 830
Maximum (no load) speedrpm	4800	4450 to 4650	4650 to 4850	4400 to 4800
Smoke test/opacityM ⁻¹ %	2.0	2.0	2.0	2.0
Static timing method.....	Refer to wsm	Refer to wsm	-	-
Timing dimension.....mm	-	-	-	-
Crankshaft positionmm [°]	-	-	-	-
Turbo type / ref / pressure.....bar	-	0.6 to 0.8 bar @ 3000 rpm	-	-
Injection pump make.....	Bosch	Bosch	-	-
Injection pump part no.....	VE	VE	-	-
Injector Make / type.....	Bosch	Bosch	-	-
Injector part no.....	0432 217 231	-	-	-
Injection type.....	Direct VE	Direct VE	Direct	Direct
Injection opening pressure, New [used]...bar	190 to 200 [≥170]	190 to 200 [≥170]	190 to 200 [≥170]	190 to 200 [≥170]
Glow plugs				
Maker.....	Bosch	Bosch	-	-
Type.....	0250 202 022	0250 202 022	-	-
Nominal rating.....V/A	11 / 12	11 / 12	-	-
Brakes				
minimum friction material thickness				
Front.....mm	2.0	3.0	3.0	3.0
Rear.....mm	2.0	3.0	3.0	3.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	195/70x15: 225/70x15	195/70x15	195/70x15	195/70x15
Pressure - front / rear - Saloon / Hatch...bar	-	-	-	-
- Estate / Vanbar	Refer to vehicle	Refer to vehicle	Refer to vehicle	Refer to vehicle
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0 ± 1.0	4.0 ± 2.0	-	-
Camber.....	0° ± 45'	0°40' ± 20'	-	-
Castor.....	0° ± 30'	2°30' ± 30'	-	-
King pin inclination.....	-	-	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	[0° ± 15']	-	-	-
Camber.....	20' -40'	-	-	-



VOLKSWAGEN

	LT 2.5 D 1996 to 1999	LT 2.5 TDi 1997 to 1999	LT 2.5 TDi 1999 to 2000	LT 2.5 TDi 1999 to 2000
Torque wrench settings				
Cylinder head - stage 1.....Nm	40 N	40 N	40 N	40 N
- stage 2.....Nm	60	60	60	60
- stage 3.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 4.....Nm	+ 90°	+ 90°	+ 90°	+ 90°
- stage 5.....Nm	-	-	-	-
- stage 6.....Nm	-	-	-	-
Big-end bearings.....Nm	30 + 90° N	30 + 90° N	30 + 90° N	30 + 90° N
Main bearings.....Nm	65	65 N	65 N	65 N
Crankshaft pulley bolt.....Nm	160 + 180° N	160 + 180° N	-	-
Camshaft pulley bolt.....Nm	85 M10.9: 100	85 M10.9: 100	-	-
Flywheel [driveplate] bolt.....Nm	60 + 90° N	60 + 90° N	60 + 90° N	60 + 90° N
Front hubs.....Nm	WSM	-	-	-
Rear hubs.....Nm	WSM	325	325	325
Wheel nuts / bolts.....Nm	180	180	180	180
Glow plugs.....Nm	25	15	-	-
Clutch pressure plate bolts.....Nm	25	25	25	25
Injection pump sprocket.....Nm	90	90	-	-
Injectors.....Nm	30	30	-	-
Injection pump mounting bolts.....Nm	45	45	-	-
Injector pipe unions.....Nm	25	25	-	-
Capacities				
Engine oil & filter.....litres	7.8	7.8	7.8	7.8
Gearbox.....litres	1.6	2.2	2.2	2.2
Automatic transmission.....litres	-	-	-	-
Final drive.....litres	1.5	1.5	1.5	1.5
Cooling system.....litres	11.5	11.5	11.5	11.5
Fuel tank.....litres	76	76	76	76

Notes



- Not applicable, or information not available



VOLKSWAGEN

LT 2.8 TDi
1997 to 2000

Engine

Engine type/code	AGK SOHC 12V Turbo 92kW
Capacity (cm ³) / cylinders	2798 / 4
Compression ration / pressure	19.1 / ≥23.0
Torque output	280 Nm
Oil pressureIdle [running] bar	[4.0 @ 3800]
Oil temperature°C	80
Valve clearances - inlet (mm)	0.20
- exhaust (mm)	0.30
Injection order	1-3-4-2
No. 1 cylinder position	FE

Cooling system

Thermostat opening temperature°C	87
Radiator cap pressurebar	1.2 to 1.5

Fuel system

Idle speedrpm	700 to 800
Maximum (no load) speedrpm	3900
Smoke test/opacityM ⁻¹ %	2.0
Static timing method.....	Dial gauge
Timing dimension.....mm	1.48
Crankshaft positionmm [°]	0 TDC
Turbo type / ref / pressurebar	-
Injection pump make	Bosch
Injection pump part no.....	-
Injector Make / type	-
Injector part no.....	-
Injection type.....	Direct
Injection opening pressure, New [used]...bar	220

Glow plugs

Maker	Beru
Type	GN855
Nominal rating.....V/A	11.5 /

Brakes

minimum friction material thickness	
Front.....mm	3.0
Rear.....mm	3.0

Tyres - Saloon / Hatch.....Size

- Estate / Van.....Size	195/70x15
Pressure - front / rear - Saloon / Hatch...bar	-
- Estate / Vanbar	Refer to vehicle

Front suspension / wheel alignment

Toe-in (+) / Toe-out (-).....mm [°]	4.0 ± 2.0
Camber	0°40' ± 20'
Castor	2°30' ± 40'
King pin inclination.....	-

Rear suspension / wheel alignment

Toe-in (+) / Toe-out (-).....mm [°]	-
Camber	-



VOLKSWAGEN

LT 2.8 TDi
1997 to 2000

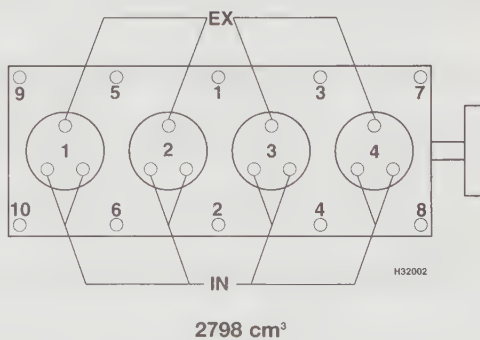
Torque wrench settings

Cylinder head - stage 1	Nm	30 N
- stage 2	Nm	60
- stage 3	Nm	100
- stage 4	Nm	+ 90°
- stage 5	Nm	+ 90°
- stage 6	Nm	-
Big-end bearings	Nm	20 + 90° N
Main bearings	Nm	25 + 120°
Crankshaft pulley bolt	Nm	100
Camshaft pulley bolt	Nm	180
Flywheel [driveplate] bolt	Nm	125
Front hubs	Nm	WSM
Rear hubs	Nm	325
Wheel nuts / bolts	Nm	180
Glow plugs	Nm	15
Clutch pressure plate bolts	Nm	25
Injection pump sprocket	Nm	90
Injectors	Nm	40
Injection pump mounting bolts	Nm	30
Injector pipe unions	Nm	25

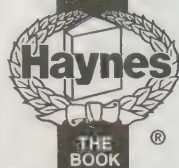
Capacities

Engine oil & filter	litres	7.0
Gearbox	litres	2.2
Automatic transmission	litres	-
Final drive	litres	1.5
Cooling system	litres	11.5
Fuel tank	litres	76

Notes



- Not applicable, or information not available



VOLVO

	440 / 460 1.9 TD 1994 to 1997	S40 & V40 1.9 TD 1996 to 2000	850 2.5 TD 1995 to 1997	S70 & V70 2.5 TD 1997 to 2000
Engine				
Engine type/code.....	D19T SOHC Turbo 68kW	D4192T SOHC Turbo EGR 68kW	D5252T SOHC 10V 103kW	D5252T SOHC 10V 103kW
Capacity (cm ³) / cylinders.....	1870 / 4	1870 / 4	2460 / 5	2460 / 5
Compression ration / pressurebar	20.5 / 20.0	20.5 / ≥16.0	20.5 / 25 to 30	20.5 / 25 to 30
Torque outputNm	180	176	290	290
Oil pressureIdle [running] bar	[3.5 @ 3000]	2.0 [3.5 @ 3000]	1.0 [3.5 to 7.0]	1.0 [3.5 to 7.0]
Oil temperature°C	80	80	80	80
Valve clearances - inlet (mm)	0.15 to 0.25	0.15 to 0.25	0: Hyd.	0: Hyd.
- exhaust (mm)	0.35 to 0.45	0.35 to 0.45	0: Hyd.	0: Hyd.
Injection order	1-3-4-2	1-3-4-2	1-2-4-5-3	1-2-4-5-3
No. 1 cylinder position	-	FE	TBE	TBE
Cooling system				
Thermostat opening temperature°C	92	89	87	87
Radiator cap pressurebar	1.5	1.2	1.5	1.5
Fuel system				
Idle speedrpm	850 ± 25	825 ± 25	840 ± 50	840 ± 50
Maximum (no load) speedrpm	4800	4450	-	-
Smoke test/opacityM ⁻¹ %	2.5	2.0	2.5	2.5
Static timing method.....	Dial gauge	Dial gauge	Refer to wsm	Refer to wsm
Timing dimension.....mm	Dimension on pump	Dimension on pump	-	-
Crankshaft positionmm [°]	0 TDC	0 TDC	-	-
Turbo type / ref / pressurebar	0.7 to 0.85 bar @ 2500 rpm	0.8 to 0.95 bar @ 4250 rpm	-	-
Injection pump make	CAV	Lucas	-	-
Injection pump part no.....	DPC R8443B 721B	DPI-N ECM	-	-
Injector Make / type.....	Roto Diesel	CAV	-	-
Injector part no.....	END4SDC 6878C	-	-	-
Injection type.....	Indirect DPC	Lucas DPI-N ECM	MSA 15.7 Direct Inj	MSA15.7 Direct inj
Injection opening pressure, New [used]...bar	130 to 135 [125]	130 to 135 [125]	190	190
Glow plugs				
Maker	Beru	Champion	Bosch	Bosch
Type	GV844	CH179	0250 202 009	0250 202 009
Nominal rating.....V/A	12 / 14	11 /	-	-
Brakes				
minimum friction material thickness				
Front.....mm	2.0	2.0	3.0	3.0
Rear.....mm	2.0	2.0	2.0	2.0
Tyres - Saloon / Hatch.....Size				
- Estate / Van.....Size	175/65x14; 185/65x15	185/65x14; 195/55x15	195/60x15; 205/55x15	195/60x15; 205/55x15
Pressure - front / rear - Saloon / Hatch...bar	2.1 / 1.9	2.2 / 2.0	2.2 / 2.0	2.2 / 2.0
- Estate / Vanbar	-	2.2 / 2.0	2.2 / 2.1	2.2 / 2.1
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	0.0 to 1.0	[0°3' ± 6']	[20' ± 6']	[20' ± 6']
Camber	-0°24' ± 1°	0° ± 1°	0° ± 1°	0° ± 1°
Castor	3°15' ± 1°	2°12' ± 1°	3°20' ± 1°	3°20' ± 1°
King pin inclination.....	13°14' ± 1°	12°41' ± 1°	-	-
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	1.0 to 4.0	[0°6' +9' -3']	[4' ± 10']	[4' ± 10']
Camber	-	-0°40' ± 30'	-1° ± 30'	-1° ± 30'



VOLVO

	440 / 460 1.9 TD 1994 to 1997	S40 & V40 1.9 TD 1996 to 2000	850 2.5 TD 1995 to 1997	S70 & V70 2.5 TD 1997 to 2000
Torque wrench settings				
Cylinder head - stage 1Nm	30 ¹	30 ¹	35	35
- stage 2Nm	+ 50°	+ 50°	60	60
- stage 3Nm	Wait 3 mins, slacken	Wait 3 mins, slacken	+ 90°	+ 90°
- stage 4Nm	25	25	+ 90°	+ 90°
- stage 5Nm	+ 213°, warm up	+ 213°, warm up	—	—
- stage 6Nm	+ 120°	+ 120°	—	—
Big-end bearings.....Nm	45 N	45 N	30 ± 3 + 90° N	30 ± 3 + 90° N
Main bearings.....Nm	65	65	65 ± 6.5	65 ± 6.5
Crankshaft pulley boltNm	95	20 + 115°	160 + 180° N	160 + 180° N
Camshaft pulley boltNm	50	50	85 ¹ Rear: 160	85 ¹
Flywheel [driveplate] bolt.....Nm	53 N	53 N	60 + 90° N	60 + 90° N
Front hubsNm	230	240	120 + 60°	120 + 60°
Rear hubs.....Nm	160	175	120 + 30°	120 + 30°
Wheel nuts / boltsNm	110	110	110	110
Glow plugsNm	23	20	15	15
Clutch pressure plate boltsNm	22	21	25	25
Injection pump sprocket.....Nm	70	WSM	45	45
Injectors.....Nm	70	70	22	22
Injection pump mounting boltsNm	20	20	25	25
Injector pipe unions.....Nm	23	22.5	25	25
Capacities				
Engine oil & filter.....litres	5.0	5.3	6.0	6.0
Gearbox.....litres	3.4	3.4	2.1	2.1
Automatic transmissionlitres	—	—	3.0	3.0
Final drive.....litres	WT	WT	WT	WT
Cooling system.....litres	7.0	5.0	12.0	7.2
Fuel tank.....litres	60	60	73	73

Notes

440 / 460 1.9 TD 1994 to 1997

¹Bolt length: ≤120.5 mm

S40 & V40 1.9 TD 1996 to 2000

¹Bolt length below head: ≤120.5 mm No re-tighten if steel gasket used

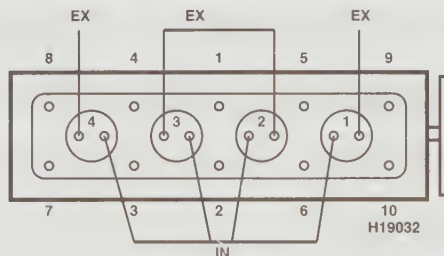
²Steel flange: 50 Nm Aluminium flange: 15 + 60°

850 2.5 TD 1995 to 1997

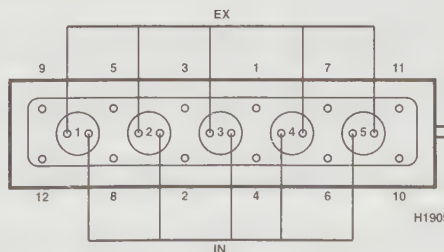
¹If marked 10.9m: 100 Nm

S70 & V70 2.5 TD 1997 to 2000

¹If marked 10.9M: 100 Nm



1870 cm³



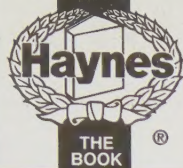
2460 cm³

— Not applicable, or information not available



VOLVO

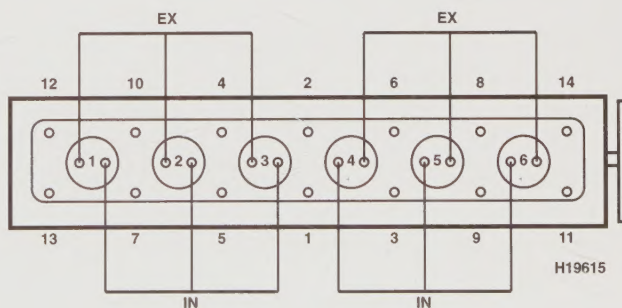
	940 2.4 TD 1990 to 1992	940 2.4 TD 1992 to 1996		
Engine				
Engine type/code	D24T SOHC Turbo 80kW	D24TIC SOHC Turbo 90kW		
Capacity (cm ³) / cylinders	2383 / 6	2383 / 6		
Compression ratio / pressure	23.0 / 24 to 32	23.0 / ≥21		
Torque output	0	235		
Oil pressureidle [running] bar	[2.0 @ 2000]	[2.0 @ 2000]		
Oil temperature°C	80	80		
Valve clearances - inlet (mm)	0.15 to 0.25	0.15 to 0.25		
- exhaust (mm)	0.35 to 0.45	0.35 to 0.45		
Injection order	1-5-3-6-2-4	1-5-3-6-2-4		
No. 1 cylinder position	TBE	TBE		
Cooling system				
Thermostat opening temperature°C	87	87		
Radiator cap pressurebar	1.5	1.5		
Fuel system				
Idle speedrpm	830 ± 40	830		
Maximum (no load) speedrpm	5400 ± 50	5400		
Smoke test/opacityM ⁻¹ %	3.0	2.0		
Static timing method.....	Plunger travel	Dial gauge		
Timing dimension.....mm	0.9 ± 0.02	0.9 ± 0.02		
Crankshaft positionmm [°]	[0] TDC	0 TDC		
Turbo type / ref / pressurebar	0.7 bar @ 3000 rpm	0.9 to 1.0 bar @ 2400 rpm		
Injection pump make	Bosch	Bosch		
Injection pump part no.....	VE L116-6	VE6/10 F2400		
Injector Make / type	Bosch	Bosch		
Injector part no.....	0432 217 078	0432 217 078		
Injection type.....	Indirect VE	Indirect VE		
Injection opening pressure, New [used]...bar	166 [145]	163 [145]		
Glow plugs				
Maker	Bosch/Champion	Bosch/Champion		
Type	0250 201 032 / CH68	0250 201 032 / CH68		
Nominal ratingV/A	-	11 / 12		
Brakes				
minimum friction material thickness				
Front.....mm	3.0	3.0		
Rear.....mm	2.0	2.0		
Tyres - Saloon / Hatch				
Size	185/70x14	185/65x15		
- Estate / Van.....Size	185/70x14	185/65x15		
Pressure - front / rear - Saloon / Hatch...bar	1.9 / 1.9	1.9 / 2.1		
- Estate / Vanbar	1.9 / 2.1	1.9 / 2.2		
Front suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	2.0 ± 0.5	2.1 ± 0.9		
Camber	-12' to 48'	0°18' ± 30'		
Castor	4°30' to 5°30'	5°0' ± 30'		
King pin inclination.....	-	-		
Rear suspension / wheel alignment				
Toe-in (+) / Toe-out (-).....mm [°]	-	-		
Camber	-	-		



VOLVO

	940 2.4 TD 1990 to 1992	940 2.4 TD 1992 to 1996		
Torque wrench settings				
Cylinder head - stage 1Nm	40 N	40 N		
- stage 2Nm	60	60		
- stage 3Nm	75 + 180°	75, + 180°		
- stage 4Nm	Warm engine + 90°	Warm up, + 90°		
- stage 5Nm	After 1000km,	After 1000km		
- stage 6Nm	Allow to cool, + 90°	Allow to cool, + 90°		
Big-end bearings.....Nm	30 + 180° N	30 + 180° N		
Main bearings.....Nm	65	65		
Crankshaft pulley boltNm	350	350		
Camshaft pulley boltNm	45 Pump end: 100	WSM		
Flywheel [driveplate] bolt.....Nm	75 LkC	75		
Front hubsNm	100 + 45°	100 + 45°		
Rear hubs.....Nm	WSM	WSM		
Wheel nuts / boltsNm	85	85		
Glow plugsNm	22	22		
Clutch pressure plate boltsNm	25	25		
Injection pump sprocket.....Nm	45	45		
Injectors.....Nm	70	70		
Injection pump mounting boltsNm	25	-		
Injector pipe unions.....Nm	25	25		
Capacities				
Engine oil & filterlitres	6.0 Cooler: 6.6	6.0		
Gearbox.....litres	2.3	2.3		
Automatic transmissionlitres	2.0	7.5		
Final drive.....litres	1.6	1.75		
Cooling system.....litres	9.5	11.0		
Fuel tank.....litres	60	75		

Notes



2383 cm³

- Not applicable, or information not available

1991
2000

HAYNES

DIESEL ENGINE SYSTEMS & DATA BOOK

This Haynes Data Book provides descriptions and explanations of most modern Diesel engine systems and their components found on cars and light commercial vehicles up to 3.5 tonnes GVW for the years 1991 to 2000. In addition, maintenance and overhaul data is provided in its own section in easy-to-use format which precludes the need for continual page turning.

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